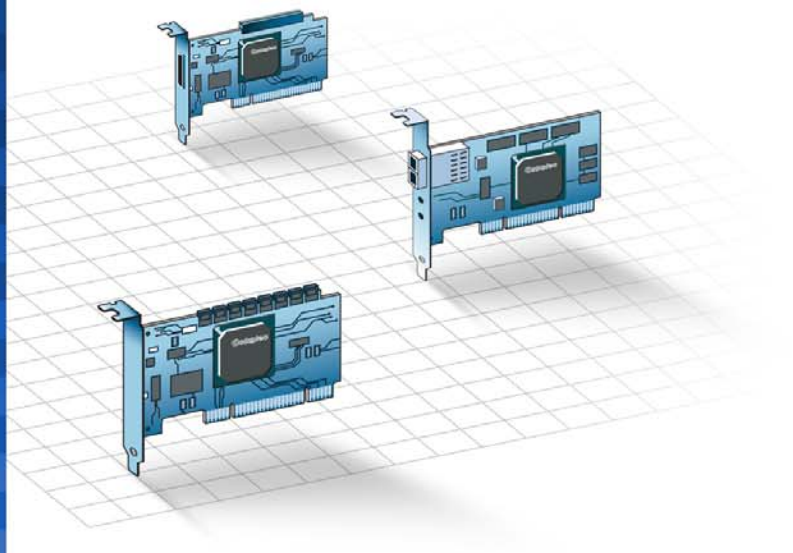
adaptec®

Serial Attached SCSI
58300, 48300, 44300
HostRAID Controllers
Installation and User's Guide



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Technical Support Identification (TSID) Number

- Before contacting Technical Support, you need your unique 12-digit TSID number. The TSID number identifies your product and support status.
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TSID: PTNNNNNNYYWW
(1P) PRODUCT P/N: PPPPPPPPPPPPPPP
(S) PRODUCT S/N: XXXXXXXXXXXXXX

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Federal Communications Commission Radio Frequency Interference Statement

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. However, if this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.
- Use a shielded and properly grounded I/O cable and power cable to ensure compliance of this unit to the specified limits of the rules.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

Adaptec, Inc.	ASR-4000SAS/ASR-4800SAS/ASR-4805SAS AAR-2420SA/AAR-2820SA

FC Tested to Comply With FCC Standards

FOR HOME OR OFFICE USE

European Union Compliance Statement

This Information Technology Equipment has been tested and found to comply with EMC Directive 89/336/EEC, as amended by 92/31/EEC and 93/68/EEC, in accordance with:

- EN55022 (1998) Emissions
- EN55024 (1998) Immunity:
  - EN61000-4-2 (1998) Electrostatic discharge: ±4 kV contact, ±8 kV air
  - EN61000-4-3 (1998) Radiated immunity
  - EN61000-4-4 (1995) Electrical fast transients/burst: ±1 kV AC, ±0.5 kV I/O
  - EN61000-4-5 (1995) Surges ±1 kV differential mode, ±2 kV common mode
  - EN61000-4-6 (1996) Conducted immunity: 3 V
  - EN61000-4-11 (1994) Supply dips and variation: 30% and 100%

In addition, all equipment requiring U.L. listing has been found to comply with EMC Directive 73/23/EEC as amended by 93/68/EEC in accordance with EN60950 with amendments A1, A2, A3, A4, A11.

Australian/New Zealand Compliance Statement

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to the Australian/New Zealand standard AS/NZS 3548 set out by the Spectrum Management Agency.

Canadian Compliance Statement

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.
Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Japanese Compliance (Voluntary Control Council Initiative)

This equipment complies to class B Information Technology equipment based on VCCI (Voluntary Control Council for Interface). This equipment is designed for home use but it may causes radio frequency interference problem if used too near to a television or radio. Please handle it correctly per this documentation.

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About This Guide

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This *Installation and User's Guide* explains how to install your Adaptec® Serial Attached SCSI controller. It also describes the utilities included in your controller kit, and provides a basic overview of Serial Attached SCSI (SAS) technology.

These HostRAID controller models are described in this Guide:

- Adaptec SAS 58300, see page 15
- Adaptec SAS 48300, see page 16
- Adaptec SAS 44300, see page 17

What You Need to Know Before You Begin

You should be familiar with computer hardware, data storage, Redundant Array of Independent Disks (RAID) technology, and the input/output (I/O) technology—SAS—used by your HostRAID controller. (For an introduction to SAS, see page 51.)

You should also be familiar with Direct Attached Storage (DAS) and Storage Area Network (SAN) concepts and technology.

Terminology Used in this Guide

Because you can use your HostRAID controller to manage data storage in a variety of configurations from DAS to SAN, the generic term "storage space" is used to refer to controller(s) and disk drives being managed with Adaptec Storage Manager™ or the other utilities described in this *Guide*.

Many of the terms and concepts referred to in this *Guide* are known to computer users by multiple names. This *Guide* uses these terms:

- Controller (also known as adapter, board, or card)
- Disk drive (also known as hard disk, hard drive, or hard disk drive)
- Array (also known as a container or logical drive)

  Note: The *Adaptec Storage Manager User's Guide* refers to arrays as logical drives. Why? Your HostRAID controller creates *arrays*, which your operating system (and Adaptec Storage Manager) recognizes as *logical drives*.

How to Find More Information

You can find more information about your HostRAID controller and the software and utilities included with it by referring to these documents:

- *Readme.txt*—Includes updated product information and known issues; located on the HostRAID Installation CD.
- *Adaptec Storage Manager User's Guide*—Describes how to install and use the Adaptec Storage Manager software (see page 40); located on the Adaptec Storage Manager Installation CD.
- *Adaptec Storage Manager online Help*—Describes how to use the Adaptec Storage Manager software; accessible from the main window of Adaptec Storage Manager.

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This chapter provides an overview of standard HostRAID controller features, and describes the unique features of your SAS HostRAID controller. It also explains how to upgrade your controller with enhanced features.

HostRAID Controller Features

- Flash ROM for updates to controller firmware Adaptec Flash Utility (AFU), BIOS, and the Array Configuration Utility (ACU).
- Event logging and broadcasting, including messaging for alphanumeric pagers.
- Support for Adaptec Metadata Format (AMF) allowing the migration of simple volumes and arrays to Adaptec RAID controller cards.
- Multiple options for creating and managing RAID arrays—A full software application (Adaptec Storage Manager), a BIOS-based utility, a command line utility, and a DOS utility. See *Managing Your Storage Space* on page 40 for more information.
- Support for disk drive hot swapping.
- Support for disk drive enclosures with SAF-TE enclosure management hardware.

Array Level Features

Note: For more information, refer to the *Adaptec Storage Manager User's Guide* or online Help.

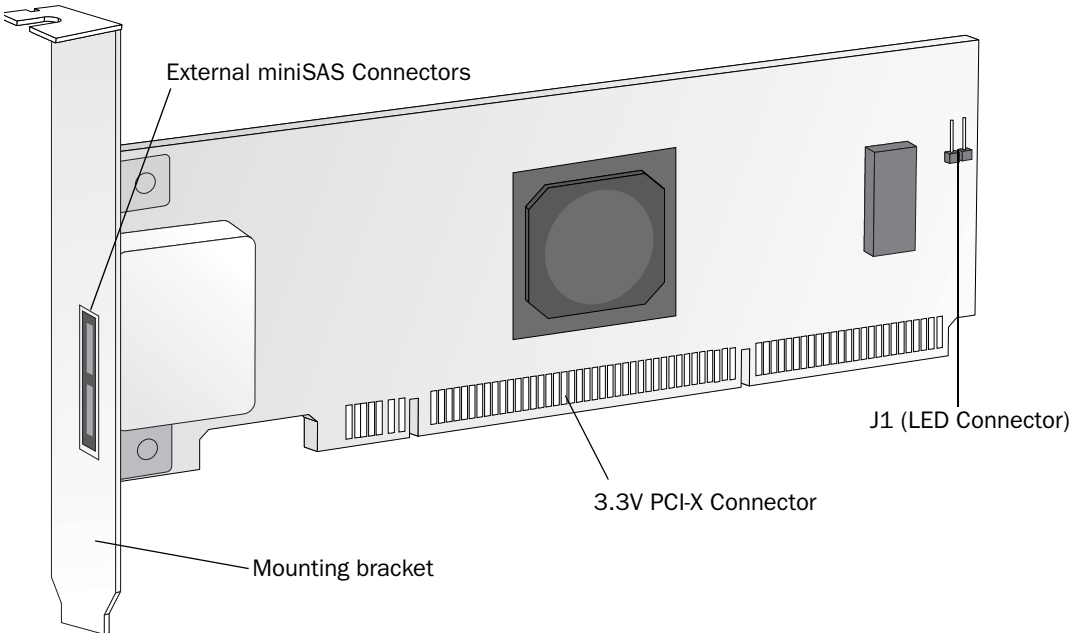
- Support for RAID 0, 1, 10, and simple volume.
- Hot swap rebuild of fault tolerant arrays through the operating system.
- Support for automatic failover, so arrays are automatically rebuilt when a failed disk drive is replaced (applies to redundant arrays in SES- or SAF-TE-enabled disk drive enclosures only).
- Global hot spare protecting every fault tolerant array that the drive has enough available capacity to protect.
- Support for RAID 0 migration.

Upgrading the HostRAID Controller Firmware

To upgrade the firmware on your HostRAID controller, see *Using the AFU for DOS* on page 69.

About the Adaptec SAS 58300 Controller

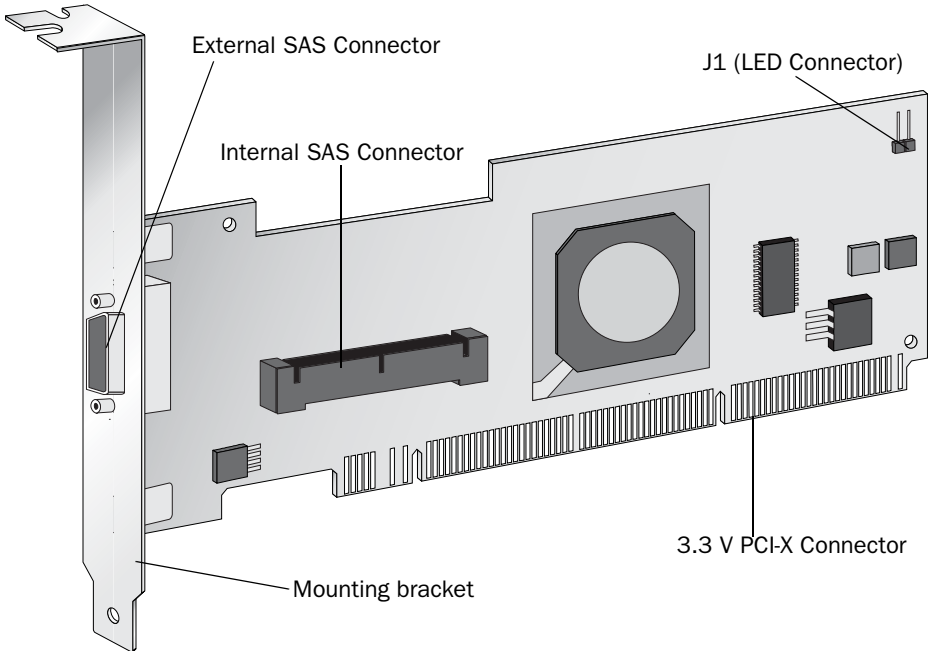
The Adaptec SAS 58300 is a low-profile PCI-X to 8-Phy SAS 1.0 HostRAID controller with these features:



Form factor	Low-profile
PCI compatibility	PCI-X
PCI bus width (max)	64-bit
PCI bus speed (max)	133 MHz
PHYs	8
Connectors, external	1 x4 internal SFF-8484 SAS 1.1 connector
RAID levels	0, 1, 10
Simple volume	Yes
Disk drives	SAS (3.0Gbps), SATA I (1.5Gbps), SATA II (3.0Gbps)
Maximum number of disk drives	8 or up to 128 using expander technology
Hot spares	Yes
Enclosure support	Yes
Automatic failover	Yes
Audible alarm	No

About the Adaptec SAS 48300 Controller

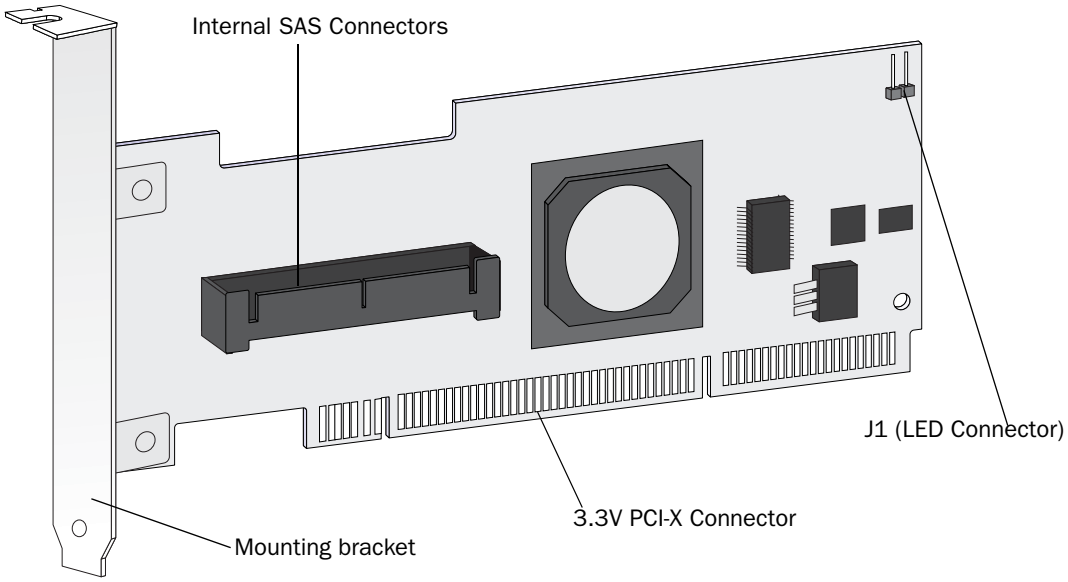
The Adaptec SAS 48300 is a low-profile PCI-X to 8-Phy SAS 1.0 HostRAID controller with these features:



Form factor	Low-profile
PCI compatibility	PCI-X
PCI bus width (max)	64-bit
PCI bus speed (max)	133 MHz
PHYs	8
Connectors, internal	1 x4 internal SFF-8484 SAS 1.1 connector
Connectors, external	1 x4 external SFF-8470 SAS 1.0 connector
RAID levels	0, 1, 10
Simple volume	Yes
Disk drives	SAS (3.0Gbps), SATA I (1.5Gbps), SATA II (3.0Gbps)
Maximum number of disk drives	8 or up to 128 using expander technology
Hot spares	Yes
Enclosure support	Yes
Automatic failover	Yes
Audible alarm	No

About the Adaptec SAS 44300 Controller

The Adaptec SAS 44300 is a low-profile PCI-X to 4-Phy SAS 1.0 HostRAID controller with these features:



Form factor	Low-profile
PCI compatibility	PCI-X
PCI bus width (max)	64-bit
PCI bus speed (max)	133 MHz
PHYs	4
Connectors, internal	1 x4 internal SFF-8484 SAS 1.1 connector
RAID levels	0, 1, 10
Simple Volume	Yes
Disk drives	SAS (3.0Gbps), SATA I (1.5Gbps), SATA II (3.0Gbps)
Maximum number of disk drives	4 or up to 128 using expander technology
Hot spares	Yes
Enclosure support	Yes
Automatic failover	Yes
Audible alarm	No

Kit Contents and System Requirements

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System Requirements 19

This chapter lists the contents of your HostRAID controller kit and the system requirements that must be met for you to successfully install and use your controller.

Kit Contents

- Adaptec SAS HostRAID controller
- HostRAID Installation CD (bootable), including controller drivers, and this *Guide*
- Adaptec Storage Manager Installation CD (not bootable), including user guides for Adaptec Storage Manager and the Adaptec HRCONF (HostRAID Configuration) command line utility
- Readme Files
- Cables (type and quantity vary for cable information about your HostRAID controller, see *About Your HostRAID Controller* on page 13)
- Low-profile bracket (*Selected models only*)
- *Serial Attached SCSI 58300, 48300, 44300 HostRAID Controllers Quick Start Guide*

System Requirements

- PC-compatible computer with Intel Pentium, or equivalent, processor
- A motherboard with these features:
  - Complies with the PCI Local Bus Specification, Revision 2.2 and higher.
  - Supports multifunction devices where one of the devices is a PCI bridge.
  - Large memory-mapped address ranges.
- One of these operating systems:
  - Microsoft® Windows®2000, Server 2003, XP
  - Red Hat Linux
  - SuSE Linux
  - Novell® NetWare®

  Note: For up-to-date operating system version support, refer to the Adaptec Web Site at www.adaptec.com.
- At least 256 MB (or more) of RAM
- An available 3.3V 32 or 64-bit PCI 2.2 or 3.3V PCI-X 133 slot
- 40 MB of free drive space
- 16-bit SVGA color monitor with a resolution of at least 800 x 600
- CD drive (that is not part of the HostRAID you are installing)
- SAS interface cables

Getting Started

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This chapter provides the basic information you need to set up your disk drives and arrays the way you want them. It also describes the options you have for installing your HostRAID controller and disk drives, and creating arrays for data storage.

> **Note:** Before you begin, familiarize yourself with your HostRAID controller's physical features and the RAID levels that it supports (see page 13).

Choosing a RAID Level

This section provides a brief overview of the RAID levels supported by your HostRAID controller, including the minimum and maximum number of disk drives required by each.

RAID 0 (Non-redundant Array)—Stripes data across multiple disk drives. Improved performance but no redundancy (see page 59).

RAID 1 Array—Created from two disk drives where one disk drive is a mirror of the other (the same data is stored on each disk drive). Redundancy, but reduced capacity (see page 60).

RAID 10 Array—Built from two or more equal-sized RAID 1 arrays, stripes and mirrors data across multiple disk drives. Redundancy and improved performance (see page 60).

Use the table on page 59 to see how many disk drives you must connect to your HostRAID controller to support the RAID level you want.

Selecting Disk Drives

When selecting disk drives for your RAID array, ensure that all the disk drives have the same performance level. You can use different-sized disk drives in the array, but the array will be limited to the capacity of the smallest and slowest disk drive.

For more information, refer to the *Adaptec Storage Manager User's Guide* or Adaptec Storage Manager online Help.

Disk Drives for Your Controller

Your SAS controller supports both SAS and SATA (Serial ATA) disk drives. For cable information, see next section.

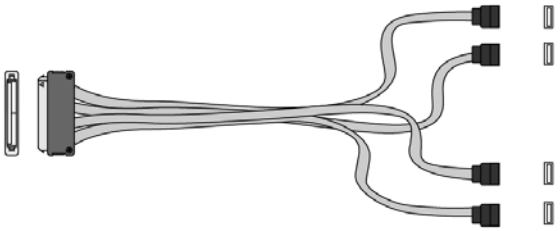
Selecting Cables

This section describes the cable options and requirements for your HostRAID controller.

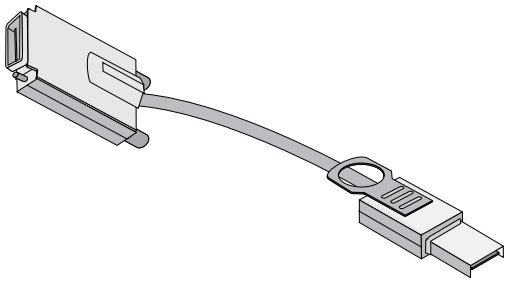
SAS Cables

You need one SAS cable for each disk drive you are connecting to your HostRAID controller.

Depending on your requirements, you can use any of these cables:



Internal fan-out cable



SAS Mini external cable

Adaptec recommends using only Adaptec SAS cables. For more information or to purchase cables, visit the Adaptec Web site at www.adaptec.com.

Installation Options

When you install your HostRAID controller, you can choose to create a bootable array and then install your operating system and the controller driver on that array.

Alternatively, you can complete a standard installation, where the controller driver is installed on an existing operating system.

Basic Installation Steps

This section describes the installation process. Follow the steps for the installation option you've chosen.

Installing with an Operating System

1. Install and connect your controller and internal disk drives (see page 24).
2. Set the boot controller (see page 30).
3. Create a bootable array (see page 29).
4. Install your operating system and the driver (see page 33).
5. Install Adaptec Storage Manager and begin to manage your data storage (see page 40).

Installing on an Existing Operating System

1 Install and connect your controller and internal disk drives (see page 24).

If your controller has an external connector, you can connect external disk drives as well (or instead).

2 Install the controller driver (see page 38).

3 Install Adaptec Storage Manager and begin to manage your data storage (see page 40).

Installing the HostRAID Controller and Disk Drives

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This chapter explains how to install your HostRAID controller, and how to install and connect internal and external disk drives.

Before You Begin

- Read the Safety Information on page 85.
- Familiarize yourself with your HostRAID controller's physical features and the RAID levels that it supports (see page 13).
- Ensure that you have the right quantity of disk drives for the RAID level you want to use for your arrays (see page 57).
- Ensure that you have the proper cables for your controller and disk drives (see page 13).
- If you have a low-profile computer cabinet, replace the original full-height bracket with the low-profile bracket supplied in the controller kit.

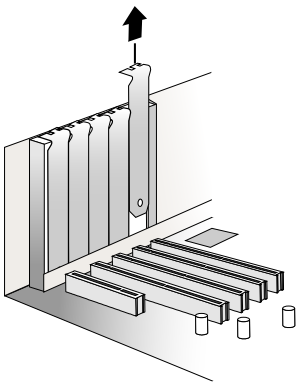
Caution: Handle the controller by its bracket or edges only.

Installing the HostRAID Controller

This section describes how to install your HostRAID controller into your computer cabinet.

1 Turn off your computer and disconnect the power cord. Open the cabinet, following the manufacturer's instructions.

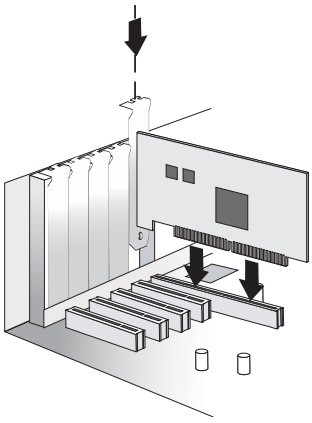
2 Select an available PCI or PCI-X expansion slot and remove the slot cover, as shown at right. (see page 13.)



For the best performance, use the available 64-bit slot that's compatible with your HostRAID controller.

Caution: Touch a grounded metal object before handling the HostRAID controller.

3 As shown at right, insert the HostRAID controller into the PCI or PCI-X expansion slot and press down gently but firmly until it clicks into place. When installed properly, the HostRAID controller should appear level with the expansion slot.



4 Secure the bracket in the PCI slot, using the retention device (for instance, a screw or lever) supplied with your computer.

5 Connect your computer's disk activity LED cable to the LED connector on the controller (see page 13).

Ensure that the positive lead of the LED cable (usually a red wire or a wire marked with a red stripe) is attached to pin 1.

6 **Optional**—Connect your HostRAID controller's I2C connector (not available on all models) to an I2C connector on an internal backplane or enclosure, using an I2C cable.

7 Install your disk drives, following the instructions on page 26.

Connecting Disk Drives to HostRAID Controllers

You can connect SAS disk drives, SATA disk drives, or a combination of both to your HostRAID controller. There are no jumpers or switches to set before installation.

If you plan to build a bootable array using internal disk drives, ensure you install at least the minimum number disk drives required to support the RAID level you want. See page 57 for more information.

> **Note:** Although you can connect both SAS and SATA disk drives to your SAS controller, Adaptec recommends that you *not* combine SAS and SATA disk drives within the same array or logical drive. See page 54 for more information.

You have two connection options:

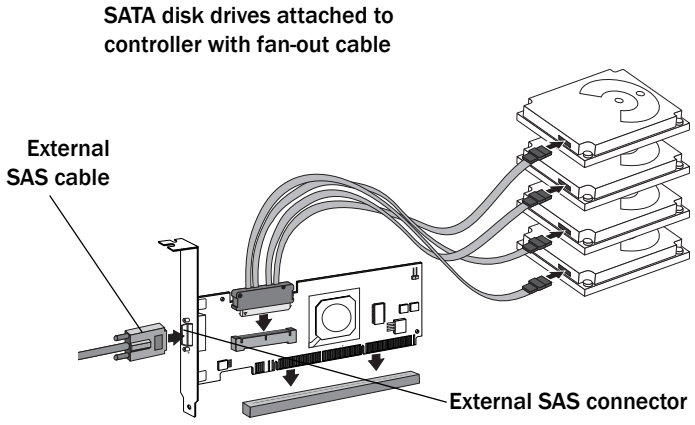
- To connect directly to the controller, see page 26.
- To connect to a backplane, see page 27.

Connecting Directly to the HostRAID Controller

In a direct-attach connection, SAS or SATA disk drives are connected directly to a SAS card with SAS cables.The number of direct-attached disk drives is limited to four per internal SAS connector. (For more information about direct-attach connections, see page 55.)

1 Install your internal SAS or SATA disk drives, following the instructions in your system's documentation.

2 Use internal SAS cables to attach the disk drives to the controller.



3 When all internal disk drives have been installed and attached to the controller, close your computer cabinet, reattach the power cord, then continue with *Installing the Controller to a SAS Expander* on page 28.

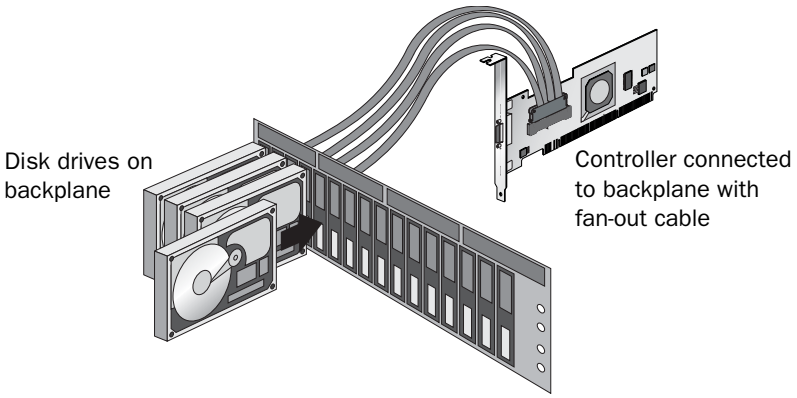
Connecting to a System Backplane

In a backplane connection, disk drives and SAS cards are attached to and communicate with each other through a system backplane.

The number of disk drives is limited to the number of slots available on the backplane. Some backplanes have embedded SAS expanders and can support up to 128 end devices. (For more information about backplane and expander connections, see page 28.)

1 Connect one or more internal SAS or SATA disk drives to the backplane. (Refer to your system's documentation for more information.)

2 Use an internal SAS cable to connect the controller to the backplane.



3 When all internal disk drives have been installed and connected, close your computer cabinet, reattach the power cord, then continue with *Installing the Controller to a SAS Expander* on page 28.

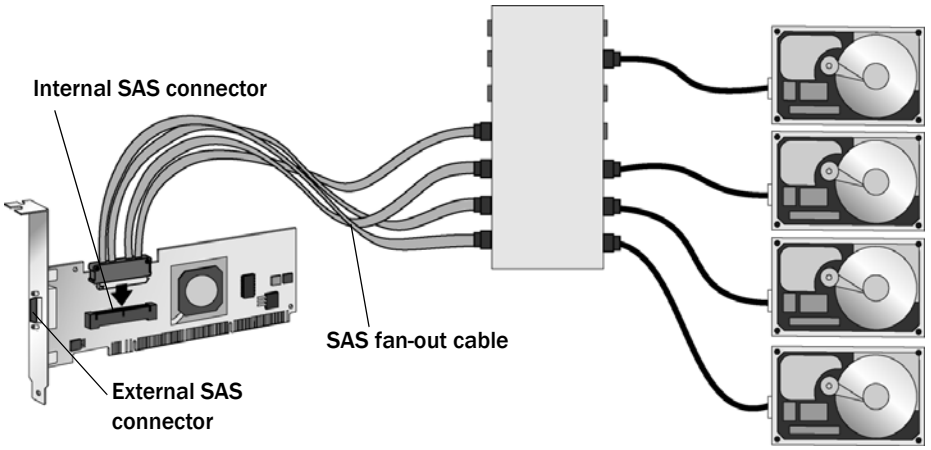
Installing the Controller to a SAS Expander

You can use a SAS edge expander to connect multiple disk drives to your HostRAID controller or multiple controllers. Commands can be sent down one link and data returned on another in a separate connection to increase fault tolerance. Using a SAS expander and dual-port SAS drives and SATA drives with 2-port adapters, you can design redundant systems for maximum fault-tolerance.

To install the HostRAID controller to a SAS expander:

1 Using the appropriate cable, connect the HostRAID controller to a PHY connector on the expander.

2 Connect a cable from a PHYconnector on the expander to a disk drive.



Next Steps

If you are installing the driver and an operating system onto a bootable array, continue with *Creating a Bootable Array* on page 29.

If you are completing a standard installation onto an existing operating system, continue with *Installing the Driver on an Existing Operating System* on page 37.

Creating a Bootable Array

6

In this chapter...

Setting the Boot Controller 30

Creating an Array 30

Creating an Array with the ACU 30

Creating an Array with Adaptec Storage Manager 31

Making Your Array Bootable 32

This chapter explains how to set your HostRAID controller to be the boot controller, and how to create a bootable array.

Note: If you are completing a standard installation onto an existing operating system, you don't have to complete this task. Skip to *Installing the Driver on an Existing Operating System* on page 37.

Setting the Boot Controller

Note: If your system won't contain more than one bootable controllers, skip this section.

Adaptec HostRAID controller supports bootable disk drives and arrays. The default setting of the HostRAID controller and system Setup allows you to install and boot from either a disk drive connected to the motherboard, or from a drive or array connected to the HostRAID controller. To enable the system to boot from either a disk drive or an array connected to the HostRAID controller:

Note: Selecting the boot controller is done under the system BIOS Setup Utility. Launching the system BIOS Setup Utility varies, see the system BIOS user's manual for more information.

1. Enter the system BIOS Setup.
2. Navigate to the disk drive boot sequence.
3. Move the boot controller to the top of the list.

Creating an Array

You can create a RAID 0, 1, or 10 array using one of these tools:

- **Array Configuration Utility** (ACU)—BIOS-based menus and keyboard navigation (see page 61).
- **Adaptec Storage Manager**—Graphical software application (running from a bootable CD) that you can navigate with your mouse (see page 41).

You can use either tool, but the ACU is the quicker and easier tool for this task.

Creating an Array with the ACU

The ACU is menu-based and instructions for completing tasks display on-screen. Menus can be navigated using the arrows, Enter, Esc, and other keys on your keyboard.

Before creating arrays, make sure the disks for the array are connected and installed in your system. Disks with no usable space are shown in gray and cannot be used. See *Physical Devices View* on page 45.

To create an array:

1. Turn on your computer and press **Ctrl+A** when prompted to access the ARC utility.
2. From the ARC menu, select **Array Configuration Utility** (ACU).
3. From the ACU Main menu, select **Create Array**.
4. Select the disks for the new array. RAID 0 and 1 requires a minimum of two disk drives. RAID 10 requires a minimum of four disk drives. Then press **Insert**.

   To deselect any disk, highlight the disk, then press **Delete**.
5. Press **Enter** when all disks for the new array are selected. The Array Properties menu displays. For Array Property Information see *Assigning Array Properties* on page 62
6. When you are finished, press **Done**.

Creating an Array with Adaptec Storage Manager

This section describes how to use the Adaptec Storage Manager configuration wizard to build a RAID 0, 1, or 10 array.

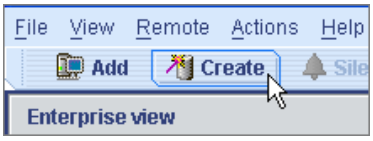
Note: You will need the HostRAID Installation CD to complete this task.

To create a RAID 0, 1, or 10 array:

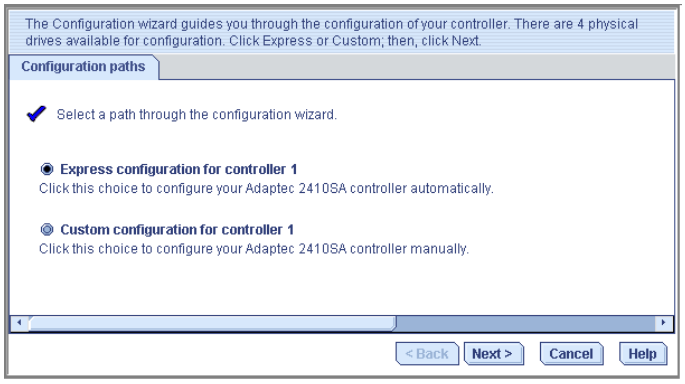
1. Insert the HostRAID Installation CD into your CD drive, then restart your computer.
2. When prompted, select the language you want, then press **Enter**.
3. Review the license information, then press **Enter**.

   The Main Menu opens.
4. Click **Launch Configuration Utility**.

   Adaptec Storage Manager opens.
5. Click **Create**.



   The Configuration wizard opens.

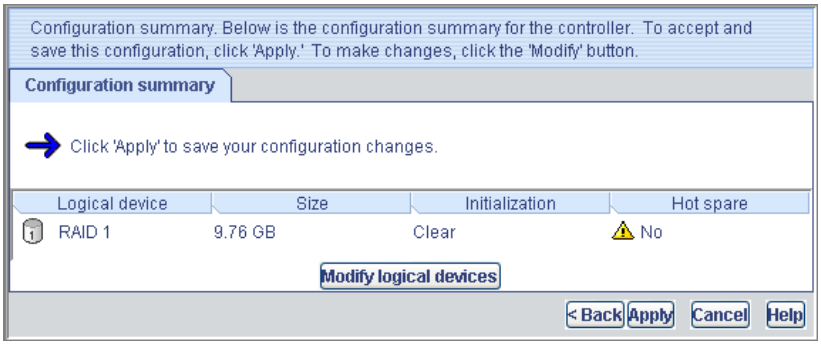

The Configuration wizard guides you through the configuration of your controller. There are 4 physical drives available for configuration. Click Express or Custom; then, click Next.
Configuration paths
Select a path through the configuration wizard.
Express configuration for controller 1
Click this choice to configure your Adaptec 2410SA controller automatically.
Custom configuration for controller 1
Click this choice to configure your Adaptec 2410SA controller manually.
< Back
Next >
Cancel
Help

6. Select **Express configuration**..., then click **Next**.

7 Review the information that is displayed.

Note: Adaptec Storage Manager uses the term logical drives when referring to arrays (see page 12).

In the following figure, Adaptec Storage Manager has used two equal-sized disk drives to automatically create one logical drive with RAID 1.



To specify a size for the logical drives, or to make other changes to the configuration, click **Modify logical devices**.

8 Click **Apply**, then click **Yes** when prompted to confirm applying your new configuration.

Adaptec Storage Manager builds the logical drive(s).

The configuration is saved on the Adaptec controller (as an "array," see page 12) and on the physical disk drives.

9 Partition and format your logical drive.

The logical drive you created appears as a physical disk drive on your operating system. You must partition and format these logical drives before you can use them to store data.

10 Close all windows, then click **Reboot** to restart your system.

11 Remove the HostRAID Installation CD.

For information on installing and using Adaptec Storage Manager as a full software application, refer to the online Help or the *Adaptec Storage Manager User's Guide*.

12 Continue with *Making Your Array Bootable* (see next section).

Making Your Array Bootable

Use the ACU to make the array bootable (see *Managing Bootable Arrays and Devices* on page 66).

Then continue with *Installing the Driver and an Operating System* on page 33.

Installing the Driver and an Operating System

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In this chapter...

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Installing with Windows 34

Installing with Red Hat Linux 35

Installing with SuSE Linux 35

Installing with NetWare 36

This chapter explains how to install your HostRAID controller driver and an operating system onto a bootable array (see page 29).

Note: To install the driver on an existing operating system, see page 37.

Before You Begin

- Install and connect your HostRAID controller and internal disk drives (see page 24).
- Create a bootable array (see page 29).
- Create a driver disk (see next section).

Creating a Driver Disk

Before you install your driver, you will need to create a driver disk. You will need a floppy disk to complete this task. To create a driver disk:

1. Set your system BIOS so that your computer boots from the CD drive. (For instructions, refer to your computer's documentation.)
2. Click **Create Driver Disk**, from the Main Menu.
3. Select one of the operating systems from the list:
   - Windows
   - Linux
   - Netware
4. Select the type of operating system you want to use.
5. Select the version of the operating system.
6. When prompted, insert a floppy disk, then click **OK**.

   The system creates the driver disk.
7. Remove and label the driver disk.
8. Continue with the instructions for your operating system:
   - For Windows, see next section.
   - For Red Hat Linux, see page 35.
   - For SuSE Linux, see page 35.
   - For NetWare, see page 36.

Installing with Windows

You will need your Windows Installation CD to complete this task. To install the HostRAID controller driver while installing Windows:

1. Insert your Windows CD, then restart the computer.
2. Follow the on-screen instructions to begin the Windows installation.
3. When prompted to install a third-party driver, press **F6**.

   Note: When F6 is active, a prompt appears at the bottom of the screen for only 5 seconds. If you miss your chance to press F6, restart your computer.

4 Insert the driver disk, then wait until you are prompted to install a driver.

5 Press **S** to specify that the driver is on a floppy disk, then press **Enter**.

The computer reads the disk.

6 When the Adaptec SAS driver is found, press **Enter**.

7 Follow the on-screen instructions to complete the installation.

8 Continue with *Managing Your Storage Space* on page 40.

Installing with Red Hat Linux

You will need your Red Hat Installation CD to complete this task. To install the HostRAID controller driver while installing Red Hat Linux:

1 Insert the first Red Hat Installation CD.

2 Restart your computer.

3 When the Red Hat Welcome screen displays, type `linux dd` at the Boot: prompt.

4 When prompted, insert the driver disk, then select **OK**.

5 Follow the prompts to set up the environment you want.

6 If you are installing other third-party devices, install them now. Otherwise, select **Done**.

7 Complete the Red Hat Linux installation, following the instructions included with your operating system.

8 Continue with *Managing Your Storage Space* on page 40.

Installing with SuSE Linux

To install the HostRAID controller driver while installing SuSE Linux:

1 Insert the first SuSE Installation CD.

2 Restart your computer.

3 When the SuSE installation selection screen displays, do the following:

- **For UL 1.0**—press the **Alt** key to have it prompt for a driver disk, select installation option from the Menu, then press **Enter**.
- **For SLES 9, SuSE 9.x and 10**—press the **F6** key, select installation option from the Menu, then press **Enter**.

4 When prompted, insert the driver disk, then press any key to continue.

5 Follow the prompts to set up the environment you want.

6 If you are installing other third-party devices, install them now. Otherwise, select **Back**.

7 Complete the SuSE Linux installation, following the instructions included with your operating system.

8 Continue with *Managing Your Storage Space* on page 40.

Installing with NetWare

You will need your NetWare Installation CD to complete this task. To install the driver when installing NetWare:

1. Restart your computer, then install NetWare. (For instructions, refer to your NetWare documentation.)

   To be able to load additional drivers later, select **Manual** install mode during the first part of the installation.

2. Click **Continue** to load additional drivers:

   a. Select **Modify** when the storage adapters are displayed.

   b. Select **Storage Adapters**, then press the **Insert** key twice to add an unlisted driver from the floppy disk.

3. When the Device Types screen displays, check the Storage adapters list, then select **Modify** to add another driver.

4. Select **Storage Adapters**, then press **Enter**.

   All recognized controllers are displayed.

5. If necessary, remove the default HostRAID SAS driver (<*driver-name*>.sys).

6. Press the **Delete** key to remove it.

7. Press **Insert** to add another driver.

   The available drivers are displayed.

8. Insert the driver floppy disk.

9. Press the **Insert** key to scan the floppy disk drive.

   Once the driver is selected, the Parameter screen is displayed.

10. From the lower window menu, select **Continue**, then press **Enter**.

    If the driver installation process fails, the server console is displayed so you can see the cause of the failure.

    To modify disk partitions, apply hot fixes, or perform volume maintenance, refer to your NetWare documentation.

11. Continue with *Managing Your Storage Space* on page 40.

Installing the Driver on an Existing Operating System

8

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Installing on Red Hat or SuSE Linux 39

Installing on NetWare 39

This chapter explains how to install your HostRAID controller driver on an existing operating system.

Note: To install the driver while you're installing an operating system, see page 33.

Before You Begin

Before you begin, install and connect your HostRAID controller and internal disk drives (see page 24).

You must also create a driver disk (see next section) before you begin installing the controller driver.

Creating a Driver Disk

Before you install your driver, you will need to create a driver disk. You will need a floppy disk to complete this task. To create a driver disk:

1. Set your system BIOS so that your computer boots from the CD drive. (For instructions, refer to your computer's documentation.)
2. Turn on your computer, then insert the HostRAID Installation CD included in your controller kit.
3. Follow the on-screen instructions to get to the Adaptec Start Menu.
4. Click **Create Driver Disk**, from the Main Menu.
5. Select one of the operating systems from this list:
   - Windows
   - Linux
   - Netware
6. Select the type of operating system you want to use.
7. Select the version of the operating system.
8. When prompted, insert the floppy disk, then click **OK**.

   The system creates the driver disk.
9. Remove and label the driver disk.
10. Continue the driver installation for your operating system:
    - For Windows, see next section.
    - For Red Hat or SuSE Linux, see page 39.
    - For NetWare, see page 39.

Installing on Windows

To install the driver on Windows:

1. Start or restart Windows.

   The Found New Hardware Wizard opens and searches for the driver.
2. Insert the driver disk, select **Floppy drive**, then click **Next**.
3. Click **Next**, then click **Next** again.
4. Follow the on-screen instructions to complete the driver installation.
5. Remove the driver disk and restart your computer.

6 Continue with *Managing Your Storage Space* on page 40.

Installing on Red Hat or SuSE Linux

To install the module on Red Hat or SuSE Linux:

1 Insert and mount the RAID Installation CD:

Red Hat—`mount /dev/cdrom /mnt/cdrom`
SuSE—`mount /dev/cdrom /media/cdrom`
UL 1.0—`mkdir /mnt/cdrom /mnt/cdrom`

2 Install the module RPM:

```
rpm -Uvh mount-point/xxx/yyy.rpm
```

where `mount-point` is the specific mount point on the Linux system, `xxx` is the driver path, and `yyy.rpm` is the rpm file.

3 Run fdisk, mkfs, and create mount points for any new disk drives.

4 Continue with *Managing Your Storage Space* on page 40.

Installing on NetWare

Note: Before you begin, ensure that your NetWare operating system has been upgraded to the minimum patch level specified by Novell. Refer to the Novell Web site for more information.

To install the driver on NetWare:

1 Start your computer.

2 From the NetWare server console prompt, type `load hdetect`, then press **Enter**.

3 From the Device types menu, select **Continue**, then press **Enter**.

4 From the Device type option, select **Modify**, then press **Enter**.

5 Select **Storage Adapters**, then press **Enter**.

6 From the Additional Driver Options menu, select **Modify**, then press **Enter**.

7 From the Driver Name menu, press the **Insert** key.

8 Insert the driver disk, press the **Insert** key, then press **F3**.

9 From the A:\ prompt, press **Enter**.

The driver installs.

10 From the Additional Driver Option menu, select **Return to driver summary**, then press **Enter**.

11 From the Driver type menu, select **Load on Additional Driver Options**.

12 After the driver loads, select **Continue**.

13 Continue with *Managing Your Storage Space* on page 40.

Managing Your Storage Space

9

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About the ARC Utility 42

About the AFU 42

Which Utility Should I Use? 42

Once you have installed your HostRAID controller, disk drives (or other devices), and device driver, you can begin to build and manage your storage space.

This chapter introduces Adaptec Storage Manager, and describes the other utilities included with your HostRAID controller.

About Adaptec Storage Manager

Adaptec Storage Manager is a full-featured software application that helps you build a storage space for your online data, using HostRAID controllers and disk drives.

With Adaptec Storage Manager, you can group disk drives into logical drives and build in redundancy to protect your data and improve system performance.

You can also use Adaptec Storage Manager to monitor and manage all the controllers and disk drives in your storage space from a single location.

When Adaptec Storage Manager is installed on a computer, the *Adaptec Storage Manager agent* is also installed automatically. The agent is like a service that keeps your storage space running. It's designed to run in the background, without user intervention, and its job is to monitor and manage system health, event notifications, tasks schedules, and other on-going processes on that system. It sends notices when tasks are completed successfully, and sounds an alarm when errors or failures occur on that system.

The agent uses less memory than the full application. If your storage space includes systems that won't be connected to monitors (and therefore won't require the user interface), you can choose to run the *agent only* on those systems instead of the full application. For more information, refer to the *Adaptec Storage Manager User's Guide* or online Help.

Installing Adaptec Storage Manager

Adaptec Storage Manager is included on the Adaptec Storage Manager Installation CD. For installation instructions, refer to the *Adaptec Storage Manager User's Guide*, also included on the Adaptec Storage Manager Installation CD.

About the HRCONF Command Line Utility

HRCONF (HostRAID Configuration Utility) is a command line utility that you can use to perform some basic array and configuration management functions.

With HRCONF, you can:

- Create and delete logical drives
- Modify and copy configuration settings
- Recover from disk drive failures and troubleshoot

Installing and Using the Command Line Utility on page 76, describes how to use HRCONF.

Note: Adaptec recommends that only advanced users familiar with command line interfaces use HRCONF.

About the ARC Utility

The Adaptec RAID Configuration (ARC) utility is a BIOS-based utility that you can use to create and manage controllers, disk drives and other devices, and arrays. The ARC utility comprises these tools:

- **Array Configuration Utility (ACU)**—For creating and managing arrays, and initializing and rescanning disk drives.
- **Serial*Select* Utility**—Used to change device and HostRAID controller settings.
- **Disk Utilities**—For formatting or verifying disk drives.

The ARC utility is included in your controller's BIOS. For more information, see *Using the ARC Utility* on page 61.

> **Note:** The ARC utility is primarily intended for pre-operating system installation configuration.

About the AFU

The Adaptec Flash Utility (AFU) is a text-based DOS utility that you can use to update, save, or verify your HostRAID controller's firmware BIOS and Non-Volatile Random Access Memory (NVRAM).

> **Caution:** Although the AFU contains safeguards to prevent you from accidentally damaging your HostRAID controller's flash contents, it is still important to use the AFU carefully and correctly to avoid rendering your HostRAID controller inoperable. Adaptec recommends that only advanced users familiar with working in DOS use the AFU.

Which Utility Should I Use?

To create a bootable array, Adaptec recommends that you use the BIOS-based ARC utility (see above).

For all subsequent storage management tasks, Adaptec recommends that you install and use Adaptec Storage Manager (see page 41). As a full-featured software application with a graphical user interface (GUI), it is the easiest to use and offers the widest range of management functions.

Understanding Adaptec Storage Manager

10

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Overview 44

Changing How Drives are Displayed 45

Collapsed and Expanded Views 46

Component Views 47

This chapter provides an overview of Adaptec Storage Manager, the user-friendly GUI that you use to easily create and manage arrays. For more details on using Adaptec Storage Manager to set up and manage arrays, refer to the online Help.

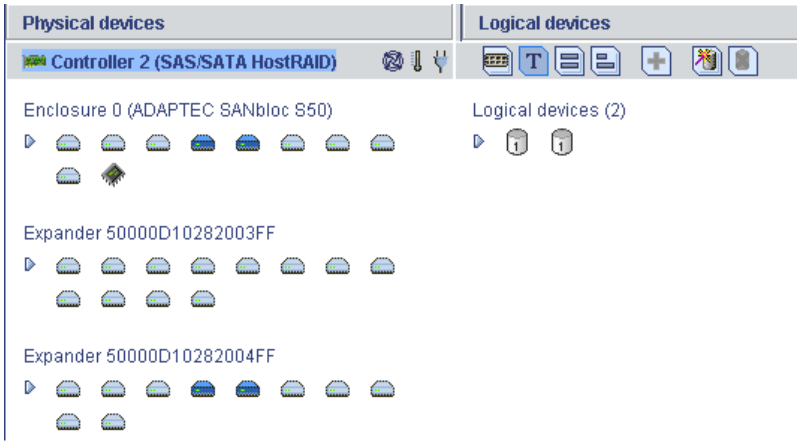
Features

You can use Adaptec Storage Manager to:

- Create, verify, modify, and delete arrays
- Add and remove hot spares
- View the RAID configuration
- View information about managed systems and subsystems such as arrays, logical drives, hot-spare drives, physical drives
- Notify systems of all events occurring on the local system
- Add or remove a remote system

Overview

Adaptec Storage Manager provides an expandable tree view of the systems and controllers you are managing. You can perform most configuration and management tasks by selecting a controller from the tree and working with related objects. The figure below shows how Adaptec Storage Manager displays information about Physical and Logical devices.



Using the buttons in the Physical devices and Logical devices views, you can:

- Change how drives are displayed
- Collapse and expand a view
- Identify components of a logical device
- Create and delete hotspares

Physical Devices View

This view displays information about the drives, enclosures, and other physical devices attached to the controller. The devices are organized numerically. The display for each channel or port includes information on maximum speed, the number of the channels on the controller, and the number of devices attached to the controller.

Indicators, next to the controller name, report status of the fan and temperature modules on SAF-TE (enclosure management) devices and other devices that monitor these conditions. The indicator colors are:

- **Blue**—Normal
- **Yellow**—Warning
- **Red**—Error
- **Gray**—Not applicable to the devices.

For example, the fan indicator changes to yellow when one fan fails; it changes to red when a second fan fails and cooling is no longer adequate.

Logical Devices View

This view displays information about the logical devices created using the physical devices, including the number of logical devices, the RAID level of each device, and whether a hot spare.

You can create and delete logical devices in the Logical devices view by selecting the Create option and using the Create wizard.

Changing How Drives are Displayed

You can choose how information is displayed in the Physical devices view by clicking one of the following buttons in the Logical devices view.

Displays physical device information in text format. This is the default view.

Displays physical device information in full size capacity format. A full-length bar is displayed for each drive, regardless of capacity. A small segment on each drive is reserved for the RAID signature; this area is indicated by a gray cap at the end of each bar.

Note: Note: A drive shaded in light blue is not part of any disk group.

Displays physical device information in relative size capacity format. A full-length bar is displayed for the largest drive; proportionally shorter bars are displayed for other drives.

Collapsed and Expanded Views

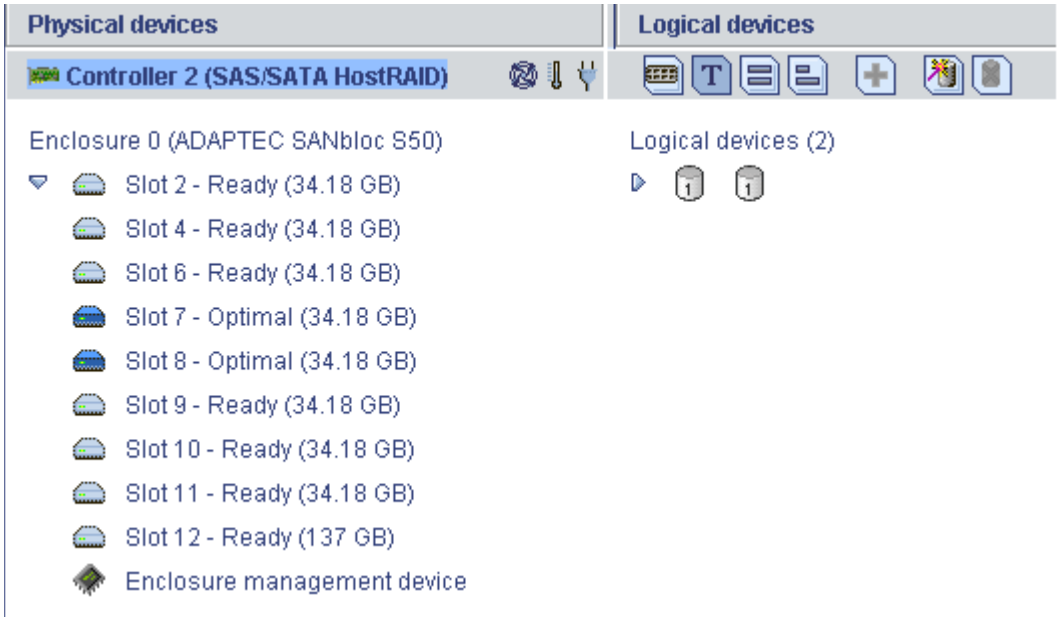
You can display a collapsed or expanded view of the system configuration. Initially, Storage Manager displays a collapsed textual view of the configuration information in both the Logical devices and Physical devices views.

In the Logical devices view...
Click to expand and collapse information about disk groups and logical devices. The expanded display shows the following information about each logical device:

- Disk group name and capacity (if available)
- Logical device size
- Logical device state
- Build progress

In the Physical devices view...
Click to expand and collapse information about physical drives. The expanded display shows the following information about each drive:

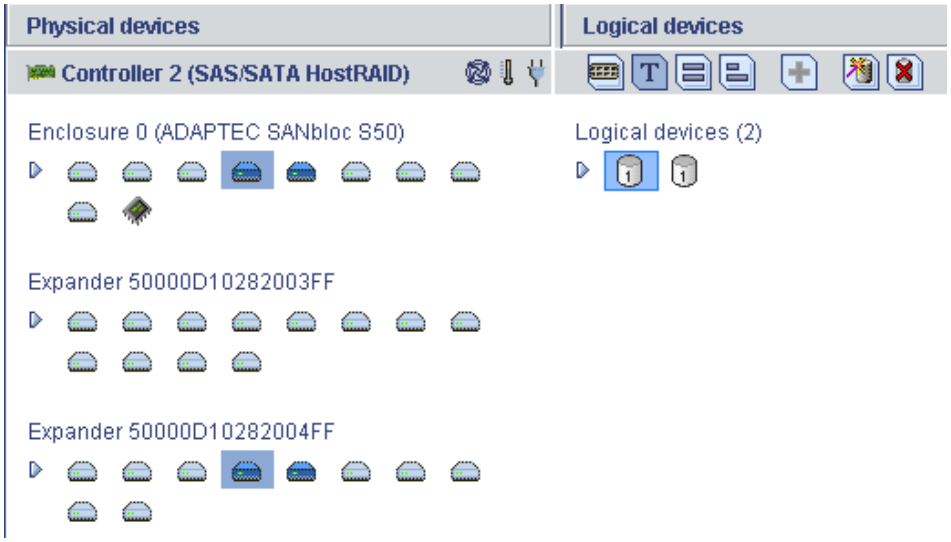
- Capacity of the drive
- Drive ID
- Drive state


Physical devices
Logical devices
Controller 2 (SAS/SATA HostRAID)
Enclosure 0 (ADAPTEC SANbloc S50)
Slot 2 - Ready (34.18 GB)
Slot 4 - Ready (34.18 GB)
Slot 6 - Ready (34.18 GB)
Slot 7 - Optimal (34.18 GB)
Slot 8 - Optimal (34.18 GB)
Slot 9 - Ready (34.18 GB)
Slot 10 - Ready (34.18 GB)
Slot 11 - Ready (34.18 GB)
Slot 12 - Ready (137 GB)
Enclosure management device
Logical devices (2)

Component Views

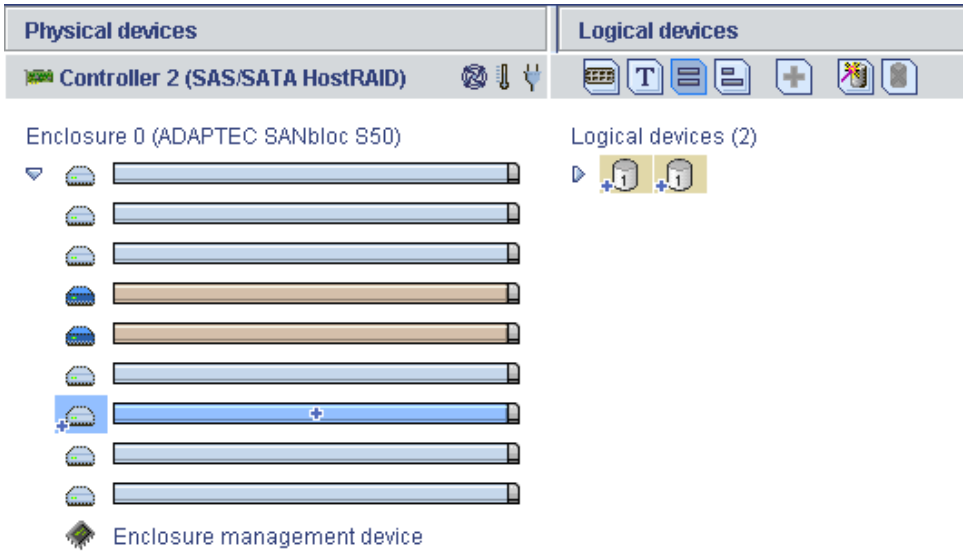
When you click a physical or logical device in the device views, the related components are highlighted in the other view.

- When you click a logical device in the Logical devices view, the physical drives that make up the logical device are highlighted in the Physical devices view, and vice-versa.



- When you click a hot spare, the logical devices protected by that spare are highlighted.

- In the graphical views, if the logical device uses only part of the available storage, only those segments are highlighted (in dark blue).



Solving Problems

11

In this chapter...

Troubleshooting Checklist 49

Recovering from a Disk Drive Failure 49

This chapter provides basic troubleshooting information and solutions for solving your HostRAID controller problems.

Troubleshooting Checklist

If you encounter difficulties installing or using your HostRAID controller, check these items first:

- With your computer powered off, check the connections to each disk drive, the power supply, the LED connector, and so on.
- Try disconnecting and reconnecting disk drives from the HostRAID controller.
- Check that your HostRAID controller is installed in a compatible expansion slot (PCI-X). To double-check the bus compatibility of your controller, see *About Your HostRAID Controller* on page 13.
- Ensure that your HostRAID controller is firmly seated and secured in the PCI-X expansion slot.
- If your HostRAID controller is not detected during system boot, try installing it in a different PCI-X expansion slot. (See page 25 for instructions.)
- Did the driver install correctly?

If you are still unable to resolve a problem, you can find additional troubleshooting information and direction on the Adaptec Web site at www.adaptec.com and the Adaptec Support Knowledgebase at ask.adaptec.com.

Recovering from a Disk Drive Failure

This section explains how to recover when a disk drive fails:

- If the array was protected by a hot spare (see next section).
- If the array was *not* protected by a hot spare (see page 50).
- If there is a disk drive failure in more than one array simultaneously (see page 50).
- If it is a RAID 0 array (see page 50).
- If multiple disk drives fail within the same array (see page 50).

> **Note:** Adaptec Storage Manager uses the term *logical drives* when referring to *arrays* (see page 12).

Failed Disk Drive Protected by a Hot Spare

When an array is protected by a hot spare, if a disk drive in that array fails the hot spare is automatically incorporated into the array and takes over for the failed drive.

To recover from the failure:

- Remove and replace the failed disk drive (following manufacturer's instructions).

Failed Disk Drive *Not* Protected by a Hot Spare

When an array is not protected by a hot spare, if a disk drive in that array fails, remove and replace the failed disk drive. The controller detects the new disk drive and begins to rebuild the array.

If the controller fails to rebuild the array, check that the cables, disk drives, and controllers are properly installed and connected. Then, if necessary, use Adaptec Storage Manager to rebuild the array. For instructions, refer to the *Adaptec Storage Manager User's Guide* or online Help.

Failure in Multiple Arrays Simultaneously

If there's a disk drive failure in more than one array at the same time (one failure per array), and the arrays have hot spares protecting them, the controller rebuilds the arrays with these limitations:

- A hot spare must be of equal or greater size than the failed disk drive it's replacing.
- Failed disk drives are replaced with hot spares in the order in which they failed. (The array that includes the disk drive that failed first is rebuilt first, assuming an appropriate hot spare is available—see bullet above.)

If there are more disk drive failures than hot spares, see *Failed Disk Drive Not Protected by a Hot Spare* in previous section.

Disk Drive Failure in a RAID 0 Array

Because RAID 0 volumes do not include redundancy, if a disk drive fails in a RAID 0 array, the data can't be recovered.

Correct the cause of the failure or replace the failed disk drives. Then, restore your data (if available).

Multiple Failures in the Same Array

If more than one disk drive fails at the same time in the same RAID 1 array, the data can't be recovered.

Correct the cause of the failure or replace the failed disk drives. Then, restore your data (if available).

In some instances, RAID 10 arrays *may* survive multiple disk drive failures, depending on which disk drives fail. For more information, refer to the *Adaptec Storage Manager User's Guide* or online Help.

Introduction to SAS

A

In this chapter...

Terminology Used in This Chapter 52
What is SAS? 52
How Do SAS Devices Communicate? 52
What's a Phy? 53
What's a SAS Port? 53
What's a SAS Address? 54
What's a SAS Connector? 54
What do SAS Cables Look Like? 54
How are Disk Drives Identified in SAS? 54
What are the SAS Connection Options? 54
How is SAS Different from Parallel SCSI? 56

This section provides a basic overview of the main features of SAS, introduces some common SAS terms, and explains how SAS differs from parallel SCSI.

Note: For technical articles and tutorials about SAS, refer to the SCSI Trade Association (STA™) Web site at www.scsita.org.

Terminology Used in This Chapter

For convenience, SAS HostRAID controllers are referred to generically in this chapter as *SAS cards*. HBAs, HostRAID controllers, disk drives, and external disk drive enclosures are referred to as *end devices* and expanders are referred to as *expander devices*.

For convenience, this chapter refers to end devices and expander devices collectively as *SAS devices*.

What is SAS?

Legacy parallel SCSI is an interface that lets devices such as computers and disk drives communicate with each other. Parallel SCSI moves multiple bits of data *in parallel* (at the same time), using the SCSI command set.

SAS is an evolution of parallel SCSI to a point-to-point serial interface. SAS also uses the SCSI command set, but moves multiple bits of data one at a time. SAS links end devices through direct-attach connections, or through expander devices.

SAS cards can typically support up to 128 end devices and can communicate with both SAS and SATA devices. (You can add 128 end devices—or even more—with the use of SAS expanders. See page 55.)

Although you can use both SAS and SATA disk drives in the same *SAS domain* (see page 55), Adaptec recommends that you not combine SAS and SATA disk drives within the same array or logical drive. The difference in performance between the two types of disk drives may adversely affect the performance of the array.

Data can move in both directions simultaneously across a SAS connection (called a *link*—see next section). Link speed is 600 MB/sec in full-duplex mode. A SAS card with eight links has a maximum bandwidth of 4800 MB/sec in full-duplex mode.

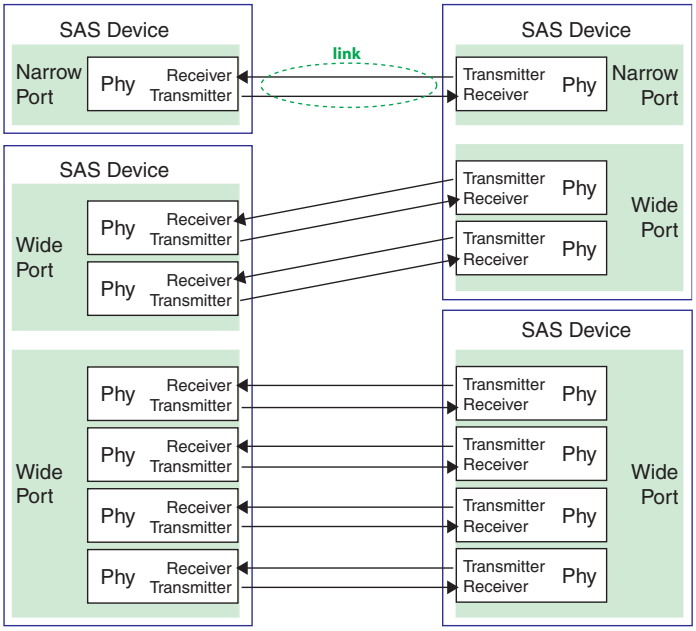
Although they share the SCSI command set, SAS is conceptually different from parallel SCSI physically, and has its own types of connectors, cables, connection options, and terminology, as described in the rest of this chapter.

To compare SAS to parallel SCSI, see *How is SAS Different from Parallel SCSI?* on page 56.

How Do SAS Devices Communicate?

SAS devices communicate with each other through links. A *link* is a physical connection between two phys.

As shown in the following figure, SAS devices contain ports which contain *phys* (see next section), and each phy contains one transmitter and one receiver—one *transceiver*. A phy can belong to one port only.



What's a Phy?

Phys are part of the physical communication connection between SAS devices. Each phy contains a transceiver that sends data back and forth between SAS devices.

When a connection is formed between two end devices, a link is established from a phy in one port to a phy in the other port. As shown in the figure above, a wide port can support multiple independent links simultaneously.

Phys are internal, within SAS connectors (see page 54).

SAS cables physically connect one or more phys on one SAS device to one or more phys on another SAS device.

What's a SAS Port?

> **Note:** Because the physical link between SAS devices is from phy to phy, rather than port to port, a "port" is more of a virtual concept, different from what is normally considered a port on other types of RAID controllers and storage devices.

A *port* is one or more phys. A *narrow port* contains one phy. A *wide port* typically contains four phys.

Each port has its own unique SAS address (see page 54), and all the phys in a port share that same SAS address.

SAS card port options vary. A SAS card with four phys could be configured with one wide port, with two wide ports that comprise two phys, or with four narrow ports each containing one phy. (A wide port with four phys is referred to as a *4-wide* or *4x* port.)

What's a SAS Address?

Each SAS port is identified with a unique SAS address, which is shared by all phys on that port.

For example, a SAS disk drive might have two narrow ports. Each port has one unique SAS address. The single phy in each port uses its port's SAS address.

In another example, a SAS device might have one 4-wide port. That port has one SAS address, which is shared by all four phys in the port.

Unlike SCSI devices and SCSI IDs, SAS devices self-configure their SAS addresses. User intervention is not required to set SAS addresses, and SAS addresses cannot be modified.

What's a SAS Connector?

A SAS connector is the physical plug or receptacle that you see on a SAS device. It supports the power and signal line cable. It's what you plug a SAS cable into, or the end of the SAS cable that's being plugged in.

A connector is what forms physical links between phys. Some SAS connectors can support multiple links. The number of links a SAS connector can support is referred to as its *width*. *Narrow* connectors support a single link; *wide* connectors support up to four links.

A single SAS device may have one or more connectors. A single SAS connector may help form links between more than two SAS devices. (For instance, as shown in the figure on page 53, the 4-wide internal SAS connector forms links with four independent disk drives.)

What do SAS Cables Look Like?

Internal SAS cables are narrower than internal parallel SCSI cables. The connectors vary in size depending on the number of links they support, from single link connectors to 4-wide (or larger) connectors. Internal fan-out cables let you attach four disk drives to a single 4-wide connector.

For an example of some internal SAS cables and an external SAS cable, see *Selecting Cables* on page 21.

How are Disk Drives Identified in SAS?

In the BIOS and in the management utilities (see page 68), disk drives are identified with numbers in this format:

XX:YY:ZZ

where *XX* is the disk drive count number, *YY* is the enclosure number, and *ZZ* is the slot number (within the enclosure). If the disk drive is not installed in an enclosure, a double dashes (--) appear instead of *YY* and *ZZ* (for instance, 01:--:--).

In parallel SCSI, *XX* is the disk drive's channel number, *YY* is the target number, and *ZZ* is the logical unit number (LUN).

What are the SAS Connection Options?

You can connect end devices to each other through direct cable connections and through backplane connections. When you use one or more expander devices (see page 55), you can create large configurations.

Direct-attach Connections

In a direct-attach connection, SAS or SATA disk drives are connected directly to a SAS card with SAS cables. One disk drive is attached to one SAS connector with one SAS cable (or multiple disk drives are attached to one SAS connector with one fan-out cable). The figure on page 26 shows an example of direct-attach connections.

The number of direct-attached disk drives is limited to the number of phys supported by the SAS card. (Note that there may be multiple phys within a single connector. See page 54.)

Backplane Connections

In a backplane connection, disk drives and SAS cards are attached to and communicate with each other through a system backplane. The figure on page 27 shows an example of backplane connections.

The number of end devices is limited to the number of slots available on the backplane. For example, the Adaptec S50 enclosure, which contains an expander, is a backplane connection that supports up to 12 SAS or SATA disk drives.

Some backplanes support daisy-chain expansion to other backplanes. For example, you can daisy-chain (connect one to the next) up to nine Adaptec S50 enclosures to a single SAS card in a host system.

SAS Expander Connections

A SAS expander device literally expands the number of end devices that you can connect together. Expander devices, typically embedded into a system backplane (see page 27), support large configurations of SAS end devices, including SAS cards and SAS and SATA disk drives. With expander devices, you can build large and complex storage topologies.

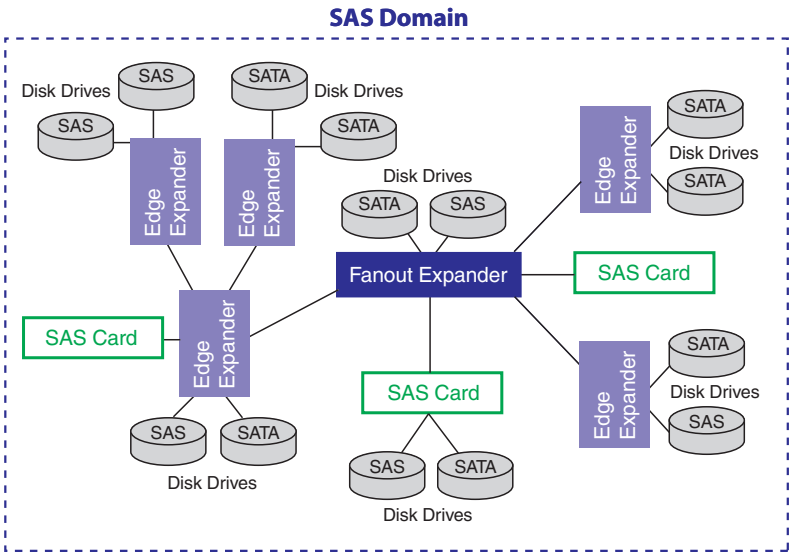
There are two types of SAS expanders: *fanout expanders* and *edge expanders*. Each performs a different role in a storage system. (For more information about how SAS expanders work, refer to the STA Web site at www.scsita.org.)

You can connect up to 128 SAS ports to an edge expander. (A single edge expander can therefore support up to 128 SAS addresses.)

You can connect up to 128 edge expanders to a fanout expander.

You can use only one fanout expander in any single SAS domain (a topology of SAS—and possibly SATA—end devices and expander devices). A single SAS domain can therefore comprise up to 16,384 SAS ports (and therefore up to 16,384 SAS addresses).

The following figure illustrates (in very basic terms) a SAS domain and shows how SAS cards, SAS and SATA disk drives, and expander devices can fit together in a large data storage topology.



How is SAS Different from Parallel SCSI?

In summary, although SAS and parallel SCSI both use the SCSI command set, how they move data from one place to another is very different. To support point-to-point *serial* data transport, SAS introduces new types of connectors, cables, connection options, and terminology.

Generally speaking, SAS is faster and more flexible than parallel SCSI, and provides more options for building your storage space. SAS lets you mix SAS and SATA disk drives together, and lets you connect many, *many* more devices.

The following table describes many of the main differences between the two interfaces.

Parallel SCSI	Serial Attached SCSI
Parallel interface	Serial interface
Maximum speed 320 MB/sec shared by all devices on the bus	Maximum speed 600 MB/sec per phy when in full-duplex mode
Supports SCSI devices only	Supports SATA and SAS disk drives simultaneously
Up to 16 devices per SCSI channel	More than 128 disk drives per SAS card, using an expander (see page 55)
Supports single-port devices only	Supports single- and dual-port devices
Uses SCSI IDs to differentiate between devices connected to the same adapter	Uses unique SAS addresses to differentiate between devices
User intervention required to set SCSI IDs	SAS addresses self-configured by SAS devices
Requires bus termination	Requires no bus termination
Standard SCSI connectors	SAS connectors (see page 21)

Understanding RAID

B

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RAID 0 (Non-RAID Arrays) 59

RAID 1 Arrays 60

RAID 10 Arrays 60

When you create arrays (or logical drives), you can assign a RAID level to protect your data.

Each RAID level offers a unique combination of performance and redundancy. RAID levels also vary by the number of disk drives they support.

This appendix describes the RAID levels supported by your HostRAID controller, and provides a basic overview of each to help you select the best level of protection for your data storage.

RAID Technology Overview

RAID is the technology of grouping several *physical* drives in a computer into an *array* that you can define as one or more logical drives. Each *logical* drive appears to the operating system as a single drive. This grouping technique greatly enhances logical-drive capacity and performance beyond the physical limitations of a single physical drive.

When you group multiple physical drives into a logical drive, the HostRAID controller can transfer data in parallel from the multiple drives in the array. This parallel transfer yields data-transfer rates that are many times higher than with non-arrayed drives, enabling the system to better meet the *throughput* (amount of data processed in a given amount of time) or productivity needs of the multiple-user network environment.

The ability to respond to multiple data requests provides not only an increase in throughput, but also a decrease in response time. The combination of parallel transfers and simultaneous responses to multiple requests enables disk arrays to provide a high level of performance in network environments.

Understanding Drive Segments

A drive segment is a disk drive or portion of a disk drive that is used to create an array. A disk drive can include both RAID segments (segments that are part of an array) and available segments. Each segment can be part of only one logical device at a time. If a disk drive is not part of any logical device, the entire disk is an available segment.

Stripe-unit Size

With RAID technology, data is *striped* across an array of physical drives. This data-distribution scheme complements the way the operating system requests data.

The granularity at which data is stored on one drive of the array before subsequent data is stored on the next drive of the array is called the *stripe-unit size*.

You can set the stripe-unit size to 16, 32, or 64 KB. You can maximize the performance of your HostRAID controller by setting the stripe-unit size to a value that is close to the size of the system I/O requests. For example, performance in transaction-based environments, which typically involve large blocks of data, might be optimal when the stripe-unit size is set to 32 or 64 KB. However, performance in file and print environments, which typically involve multiple small blocks of data, might be optimal when the stripe-unit size is set to 16 KB.

The collection of stripe units, from the first drive of the array to the last drive of the array, is called a *stripe*.

Selecting a RAID Level and Tuning Performance

Disk arrays are used to improve performance and reliability. The amount of improvement depends on the application programs that you run on the server and the RAID levels that you assign to the logical drives.

Each RAID level provides different levels of fault-tolerance (data redundancy), utilization of physical drive capacity, and read and write performance. In addition, the RAID levels differ in regard to the minimum and maximum number of physical drives that are supported.

When selecting a RAID level for your system, consider the following factors.

RAID Level	Data Redundancy	Physical Drive Capacity Utilization	Read Performance	Write Performance	Built-In Spare Drive	Min Number of Drives	Max Number of Drives
0	No	100%	Superior	Superior	No	1	4
1	Yes	50%	Very high	Very high	No	2	2
10	Yes	50%	Very high	Very high	No	4	4

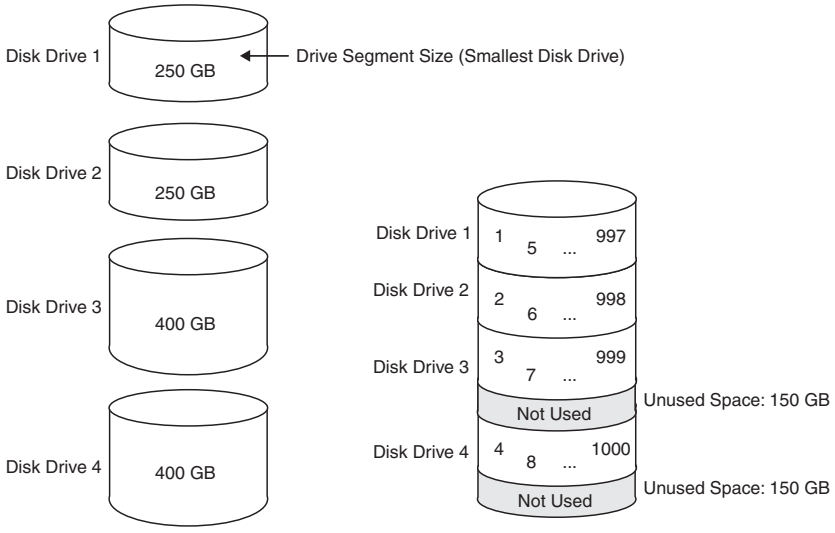
Physical drive utilization, read performance, and write performance depend on the number of drives in the array. Generally, the more drives in the array, the better the performance.

RAID 0 (Non-RAID Arrays)

An array with RAID 0 includes two or more disk drives (maximum twelve) and provides data *striping*, where data is distributed evenly across the disk drives in equal-sized sections.

RAID 0 arrays do not maintain redundant data, so they offer no data protection. However, compared to an equal-sized group of independent disks, a RAID 0 array provides improved I/O performance.

Drive segment size is limited to the size of the smallest disk drive in the array. For instance, an array with two 250 GB disk drives and two 400 GB disk drives can create a RAID 0 drive segment of 250 GB, for a total of 1000 GB for the volume, as shown in the following figure.

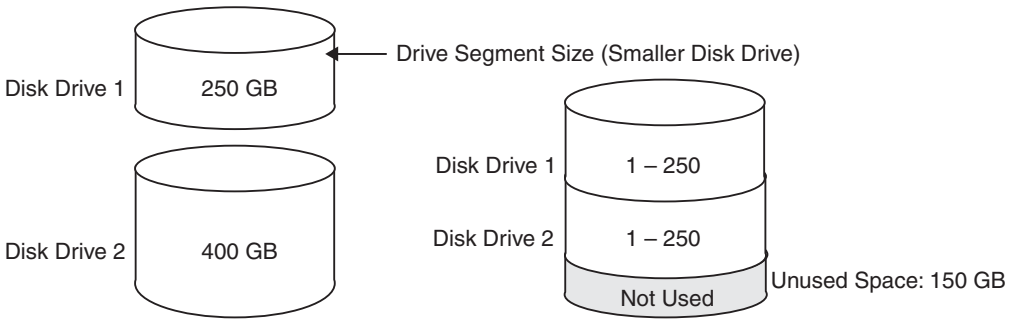


Disk Drives in Logical Drive **RAID 0 Logical Drive = 1000 GB**

RAID 1 Arrays

A RAID 1 array is built from two disk drives, where one disk drive is a *mirror* of the other (the same data is stored on each disk drive). Compared to independent disk drives, RAID 1 arrays provide improved performance, with twice the read rate and an equal write rate of single disks. However, capacity is only 50 percent of independent disk drives.

If the RAID 1 array is built from different-sized disk drives, the free space, drive segment size is the size of the smaller disk drive, as shown in the following figure.



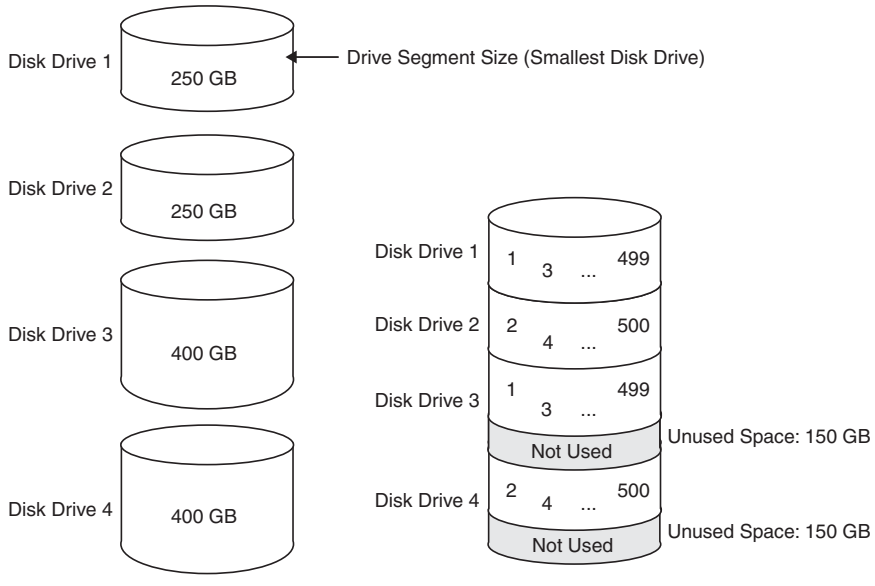
Disk Drives in Logical Drive **RAID 1 Logical Drive = 250 GB**

RAID 10 Arrays

A RAID 10 array is built from two or more equal-sized RAID 1 arrays. Adaptec RAID controllers support a maximum number of 48 disk drives in a RAID 10 array.

Data in a RAID 10 array is both striped and mirrored. Mirroring provides data protection, and striping improves performance.

Drive segment size is limited to the size of the smallest disk drive in the array. For instance, an array with two 250 GB disk drives and two 400 GB disk drives can create two mirrored drive segments of 250 GB, for a total of 500 GB for the array, as shown in the following figure.



Disk Drives in Logical Drive **RAID 10 Logical Drive = 500 GB**

Using the ARC Utility

C

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Running the ARC Utility 62

Creating and Managing Arrays 62

Using SerialSelect 66

Formatting and Verifying Disk Drives 68

The Adaptec RAID Configuration (ARC) utility is an embedded BIOS-based utility that you can use to create, configure, and manage arrays, and format or verify disk drives.

Note: Adaptec recommends that only advanced users familiar with working in a computer BIOS use the ARC utility tools.

Introduction to the ARC Utility

The ARC utility comprises these tools:

- **The Array Configuration Utility** (ACU)—Used to create, configure, and manage arrays, and initialize and rescan disk drives.
- **Serial*Select* Utility**—Used to change device and HostRAID controller settings.
- **Disk Utilities**—Used to format or verify disk drives (see page 68).

Running the ARC Utility

All the tools within the ARC utility are menu-based and instructions for completing tasks display on-screen. Menus can be navigated using the arrows, Enter, Esc, and other keys on your keyboard.

To run the Utility:

1 Start or restart your computer. When prompted, press **Ctrl+A**.

The ARC utility menu displays presenting these options:

- Array Configuration Utility (ACU)
- Serial*Select* Utility
- Disk utilities

To select an option from this menu, or from any of the menus within the ARC utility setup, browse with the arrow keys, then press **Enter**. In some cases, selecting an options displays another menu. To return to the previous menu at any time, press **Esc**.

Creating and Managing Arrays

Before creating arrays, make sure the disks for the array are connected and installed in your system. Note that disks with no usable space are shown in gray and cannot be used.

Creating a New Array

To create an array:

1 Select **Create Array** from the main ACU menu.

Note: For more information about RAID levels and using disk drives to create arrays, see *Understanding RAID* on page 57.

2 Select the disks for the new array, then press **Insert**. To deselect any disk, highlight the disk, then press **Delete**.

3 Press **Enter** when all disks for the new array are selected. The Array Properties menu displays.

Assigning Array Properties

Once the array is created and its properties are assigned, you cannot change the array properties using the ACU. Instead, use Adaptec Storage Manager (See Chapter 10, for details.)

To assign properties to the new array:

1 In the Array Properties menu, select an array type, then press **Enter**.

Only the available array types, RAID 0, 1, and 10 are displayed. RAID 0 and 1 requires two to four drives. RAID 10 requires a minimum of four disk drives.

2 **Optional**: Type a label of no more than 15 characters for the array, then press **Enter**.

3 For RAID 0, select the desired stripe size. Available stripe sizes are 16, 32, and 64 KB (default).

Note: It is recommended that you do not change the default.

4 The options under **Create RAID Via** allows you to select between the different creation methods for RAID 0, 1, and 10. The following table gives examples of when each is appropriate.

RAID Level	Create RAID Via	When Appropriate
RAID 0	Quick Init	Creating a RAID 0 on new drives.
RAID 0	Migrate	Creating a RAID 0 and you want to preserve data on an existing drive. You will be asked to select the source drive. The contents of the source drive are preserved and any data on the new drive is lost.
RAID 1	Build	Creating a RAID 1 and you want to preserve data on an existing drive. You will be asked to select the source drive. The contents of the source drive are preserved and any data on the new drive is lost.
RAID 1, 10	Clear	Creating a RAID 1 or 10 on new drives, or when you want to ensure that the new array contains no existing data.
RAID 1, 10	Quick Init	Fastest way to create a RAID 1 or 10. Appropriate when using a new drive.

Note:

- Before adding a new drive to an array, back up any data contained on the new drive. Otherwise, all data will be lost.
- Only disk drives that were previously configured as simple volumes can be used for RAID 0 or 1 migration when the single/source drive has data on it. See *Configuring Disk Drives* on page 66 to create a simple volume.
- If you stop the build or clear process on a RAID 1 from ACU, you can restart it by pressing **Ctrl**+**R**.
- A RAID 1 and 10 created using the Quick Init option may return some data miscompares if you later run a consistency check. This is normal and is not a cause for concern.
- If you stop the migration process on a RAID 0, you can restart it by pressing **Ctrl**+**R**.
- To modify the Write Cache setting for an array, press **Ctrl**+**W**.
- The ACU allows you to use drives of different sizes in a RAID 1. However, during a build operation, only the smaller drive can be selected as the source drive.

- When migrating from single volume to RAID 0, migrating from a larger drive to a smaller drive is allowed. However, the destination drive must be at least half the capacity of the source drive.
- It is not recommend that you migrate or build an array on Windows dynamic disks (volumes), as it will result in data loss.

5 When you are finished, press **Done**.

Managing Arrays

Select the **Manage Arrays** option to perform these tasks:

- Rebuild Arrays
- View Array Properties
- Delete Arrays
- Enable/Disable Write Cache
- Verify Arrays

The following sections describe these operations in greater detail.

Rebuilding Arrays

Note: Rebuilding applies to Fault Tolerant arrays (RAID 1) only.

By replacing a failed drive of a RAID 1 array with a new drive, you can rebuild to get the array to Optimal status and assume fault tolerance. You can perform a rebuild in the following ways:

Note: If no spare exists and a hard disk drive fails, you need to create a spare before you can rebuild an array. See *Adding/Deleting Hotspares* on page 65 before continuing your rebuild.

- **System Shutdown Rebuild**

  You can shut down the system and replace the failed drive with a new one (of equal or greater capacity). When the system is booted, you can assign the new drive as a spare, and this will start the Rebuild task. All the data from the good drive is copied to the new one, and the original RAID 1 array is recreated.

- **Manual Rebuild**

  a From the Main Menu, select **Manage Arrays**. From the List of Arrays, select the array you want to rebuild.

  b Press **Ctrl**+**R** to rebuild.

Viewing Array Properties

To view the properties of an existing array:

1 From the ACU menu, select **Manage Arrays**.

2 From the List of Arrays dialog box, select the array you want to view, then press **Enter**.

The Array Properties dialog box appears, showing detailed information on the array. The physical disks associated with the array are displayed here.

3 Press **Esc** to return to the previous menu.

Deleting Arrays

Caution: Back up the data on an array before you delete it. Otherwise, all data on the array is lost. Deleted arrays cannot be restored.

To delete an existing array:

1. From the ACU menu, select **Manage Arrays**.
2. Select the array you wish to delete, then press **Delete**.
3. In the Array Properties dialog box, select **Delete**, then press **Enter**. The following prompt is displayed:

   For RAID 1 and 10 arrays:

   Warning: Deleting the array will render array unusable. Do you want to delete the array? (Yes/No):

   For RAID 0 arrays:

   Warning: Deleting the array will result in data loss! Do you want to delete the array? (Yes/No):

4. If you press **Yes**, select the member when the following prompt is displayed:

   To delete the partition table, choose which member:
   member #0, member #1, both, none

5. Press **Esc** to return to the previous menu.

Enabling/Disabling Write Cache

To Enable/Disable Write Cache for an array:

1. From the Main menu, select **Manage Arrays**.
2. From the List of Arrays, select the array you want to modify the Write Cache setting for, then press **Ctrl+W**. A confirmation dialog appears to modify setting. Press **Y** to change the current Write Cache setting.

   Note: Write Cache is disabled by default when creating all array types. The disk operation may be very slow with Write Cache off.

Adding/Deleting Hotspares

Select the **Add/Delete Hotspares** option to add, delete, or view hot spares.

1. From the ACU menu, select **Add/Delete Hotspares**.
2. Use the up and down arrow keys to highlight the disk you want to designate as a hot spare, then select **Insert>Enter**.
3. Press **Yes** when the following prompt is displayed:

   Do you want to create spare? (Yes/No)

   The Spare you have selected appears in the Selected Drive menu.

Managing Bootable Arrays and Devices

Select the **Manager Boot Unit** option to add or remove a bootable array or single drive.

1 From the ACU menu, select **Manage Boot Unit**.

2 Use the up and down arrow keys to highlight the array or single drive you want to designate as a bootable device, then select **Insert**>**Enter**.

Configuring Disk Drives

Caution:

- If the drive is used in an array, you may not be able to use the array again. Do not configure a drive that is part of a boot array. To determine which drives are associated with a particular array, see *Viewing Array Properties* on page 64.
- The partition table on the disk will be deleted when deleting a simple volume.

Note: Configuring disk drives makes a simple volume. A simple volume can be managed like normal arrays by using the Manage Arrays option on your Main menu.

To configure drives:

1 From the menu, select **Configure Drives**.

2 Use the up and down arrow keys to highlight the disk you wish to configure, then press **Insert**.

3 Repeat Step 2 if you want to add another drive to be configured.

4 Press **Enter**.

5 Read the warning message and ensure that you have selected the correct disk drives to configure. Type `Y` to continue.

Using Serial*Select*

The Serial*Select* utility allows you to change the BIOS and HostRAID controller and device settings without opening the computer cabinet.

For information on the Serial*Select* options, see *SerialSelect Options* on page 67. To access Serial*Select*:

1 Restart the computer, then press **Ctrl**+**A** when prompted to access the ARC utility.

2 If multiple HostRAID controllers are installed, select the HostRAID controller you want to configure, then press **Enter**.

3 From the ARC menu, select **Serial*Select* Utility**.

4 To select a menu option, browse with the arrow keys to the option, then press **Enter**. In some cases, selecting an option displays another menu. You can return to the previous menu at any time by pressing **Esc**.

5 To restore the original Serial*Select* default values, press **F6** from within the SAS Driver and Controller Configuration screens.

6 To exit Serial*Select*, press **Esc** until a message prompts you to exit (if you changed any settings, you are prompted to save the changes before you exit).

7 At the prompt, select **Yes** to exit, then press any key to restart the computer. Any changes you made in Serial*Select* take effect after the computer restarts.

Serial*Select* Options

The following table lists the available and default settings for each Serial*Select* option and the description of each option. The default settings are appropriate for most systems and appear in bold type in the table. Adaptec recommends that you do not change the settings.

Serial*Select* Options	Available Settings	Description
Controller Configuration		
Runtime BIOS	**Enabled** Disabled Disabled:Scan bus	Controls the state of the BIOS at POST time. When **Enabled**, the HostRAID controller BIOS allows the controller to act as a bootable device. Disabling the BIOS allows another suitable HostRAID controller to act as the boot device.
BBS Support	**Device** Controller	When BBS support is set to **Device** base, the system's BIOS will list each attached bootable device to the HostRAID controller as an individual entry. When BBS support is set to Controller base, the system's BIOS will only list the HostRAID controller in the system boot order. This is useful in a multi-HostRAID controller configuration.
RAID Support	**Enabled** Disabled	When there are active arrays in the system, will not allow you to **Disable** RAID support.
POST Banner Display	**Enabled** Disabled	When **Enabled**, the Adaptec banner, version, and copyright is displayed. When Disabled, the Adaptec banner, version, and copyright is not displayed.
CTRL-A Message	**Enabled** Disabled	When set to **Enabled**, the SAS HostRAID controller BIOS displays the Press <Ctrl> <A> for ARC Utility message on your screen during system bootup. If this setting is disabled, you can still invoke the ARC utility by pressing Ctrl+A after the SAS card BIOS banner appears.
Physical Drives Display during Post	**Enabled** Disabled	When **Enabled**, attached physical devices are displayed during system POST. Displaying the devices adds a few seconds to the overall POST time.
PHY Configuration		
PHY Rate	**Auto**, 1.5, 3.0	The data transfer rate between the HostRAID controller and devices. The default setting is **Automatic**, which allows the SAS card to adjust the speed as needed.
SAS Address	**0**-F	Specifies the last digit of a 64-bit SAS address of the HostRAID controller, device, and each port using a globally unique worldwide name (WWN) identifier.
Controller Properties		
PCI Slot: Bus: Device:Function	None	Displays the path of the storage devices in a Host RAID controller.
Interrupt (IRQ) Channel	None	Displays interrupt
I/O Port Address	None	Displays I/O port address

SerialSelect Options	Available Settings	Description
Device ID	None	Displays device ID
Controller Serial Number	None	Displays controller serial number
Controller WWN	None	Displays the controller WWN

Formatting and Verifying Disk Drives

You can use the disk utilities to low-level format or verify your disk drives. (New disk drives are low-level formatted at the factory and do not need to be low-level formatted again.)

Caution: Before you format a disk drive, back up all data. Formatting destroys all data on a disk drive.

To use the disk utilities:

1. Turn on your computer and press **Ctrl+A** when prompted to access the ARC utility.
2. From the ARC utility menu, select **Disk Utilities**.
3. Select the desired disk, then press **Enter**.

   You are offered the following options:

   - **Format Disk**—Simulates a low-level format of the disk drive by writing zeros to the entire disk. SATA drives are low-level formatted at the factory and do not need to be low-level formatted again.

     Caution: Formatting destroys all data on the disk. Be sure to back up your data before performing this operation.

   - **Verify Disk Media**—Scans the media of a disk drive for defects.

Using the AFU for DOS

D

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AFU Command Line – Step-by-Step 74

This chapter describes how to use the Adaptec Flash Utility (AFU), a text-based DOS utility that you can use to update, save, or verify the HostRAID controller's firmware BIOS.

Caution: Although the AFU contains safeguards to prevent you from accidentally damaging your HostRAID controller's flash contents, it is still important to use the AFU carefully and correctly to avoid rendering your HostRAID controller inoperable. Adaptec recommends that only advanced users familiar with working in DOS use the AFU. For more information, see *Managing Your Storage Space* on page 40.

Introduction

The AFU is a DOS utility used to update, save, or verify the HostRAID controller's firmware BIOS.

The AFU is easy to use and contains safeguards to prevent you from accidentally damaging the HostRAID controller's flash contents. Still, you must be careful to use the AFU correctly, otherwise, you could render the HostRAID controller inoperable.

The AFU is used to:

- **Update**—Updates all the flash components on a HostRAID controller with the flash image data from a User Flash Image (UFI) file.

  The AFU updates the HostRAID controller's flash by reading UFI files and writing them to the controller's flash components.

  Note: The UFI includes the HostRAID controller's type, thereby ensuring that the AFU uses the correct file.

- **Save**—Updates and verifies the BIOS image of the controller.
- **Verify**—Reads the contents of a HostRAID controller's flash components and compares it to the contents of the specified UFI file.
- **Version**—Displays version information about a HostRAID controller's flash components.
- **List**—Lists all supported HostRAID controllers detected in your system.

System Requirements

The requirements for AFU are as follows:

- MS–DOS version 5.0 or later. It cannot run from a DOS command prompt window under any version of Windows.

  Note: You cannot create a bootable floppy using Windows 2000.

- At least 8 MB of extended memory.

Compatibility

The AFU has the following compatibility issues:

- Supports HIMEM.SYS and is compatible with other DOS drivers running under HIMEM.SYS (for example, SMARTDRV.SYS and SETVER.SYS).
- Does not support DOS extenders installed in memory, such as EMM386.SYS and DOS4GW.

Running the AFU from the GUI

The easy way to run the AFU is to use its GUI. If you prefer to run the AFU from the command line, see *Running the AFU from the Command Line* on page 71.

To access the AFU:

1 Shut down your operating system and reboot to DOS from a bootable MS-DOS floppy disk or from a DOS partition on a bootable drive. (You can use the drive connected to the HostRAID controller you are updating.)

Note: When updating the HostRAID controller flash, controller activity is not possible. Before you can use the HostRAID controller again, complete the flash operation and restart the computer.

2 At the DOS command prompt (typically A:\>) type `AFU`, then press **Enter**.

The AFU's main menu is displayed.

3 Select **Select Controllers**, then select the Adaptec HostRAID controllers to be flashed. When selecting a single controller, the system automatically selects it. When selecting multiple controllers, use the spacebar, then press **Enter**.

4 Select **Select an Operation** and choose one of the available options, then follow the on-screen instructions.

Running the AFU from the Command Line

At the DOS command prompt (typically A:\>), type `AFU` followed by a command and any switches. The AFU processes the command, prompts you to insert additional floppy disks as needed, exits, and reports success or an error message code. The following available commands are summarized in alphabetical order.

HELP

The `HELP` command displays a summary of AFU functions and command switches.

Examples

The following are examples of command syntax that will work to get help:

```
A:\> AFU HELP
```

```
A:\> AFU /?
```

LIST

The `LIST` command displays the AFU-supported HostRAID controllers installed on your computer. Use this command to see which HostRAID controllers are installed, or to identify the ID numbers assigned to each physical controller.

You do not have to restart the computer after completing this command.

Example

This example shows a typical system response to a `LIST` command:

```
A:\> AFU LIST
```

```
Adaptec Flash Utility V1.0-0 B1406
(c)Adaptec Inc. 1999-2005. All Rights Reserved.
Controllers Detected and Recognized:
Controller #0 (03:01:00) Adaptec ASC-48300
```

SAVE

The SAVE command saves the contents of a HostRAID controller's flash in a UFI file. The name of the UFI file is based on the HostRAID controller type and cannot be changed.

Command Syntax

The command syntax for the SAVE command is as follows:

```
AFU SAVE [/C<Controller ID>] [/D <UFI File Path>]
```

Command Switches

The following switches are available:

- /C <*Controller ID*> is one or more HostRAID controller IDs representing the set of controllers on which to perform the specified command. The default is 0, which means that if the computer has multiple HostRAID controllers, the AFU defaults to controller 0 unless you specify otherwise.

  You can specify a single HostRAID controller ID, for example:

  ```
  /C 0
  ```

  multiple IDs separated by commas, for example:

  ```
  /C 0,2
  ```

  or ALL to indicate all HostRAID controllers.

  Note: If you are using multiple HostRAID controllers, you must specify the controller you want by using the /C switch; otherwise, the AFU displays an error message and exits. You cannot select ALL HostRAID controllers when specifying SAVE.

- /D <*UFI File Path*> specifies the path (drive and directory) where the UFI files are located. If you do not specify the /D switch, the AFU looks for, or creates, UFI files in the default location.

  Note: You cannot specify the name of a UFI file, only its path. UFI filenames are predefined, based on the HostRAID controller type.

Examples

In the following example, the AFU saves flash contents from HostRAID controller 0 to a UFI file in the current default drive and directory:

```
A:\> AFU SAVE /C 0
```

In the following example, the AFU saves flash contents from Controller 1 to a UFI file in C:\UFI_FILES.

```
A:\> AFU SAVE /C 1 /D C:\UFI_FILES
```

UPDATE

The UPDATE command updates a HostRAID controller's flash components from the flash image data in a UFI file. You can use the UPDATE command to update a single HostRAID controller's flash components or to update multiple HostRAID controllers on your computer.

You must restart the computer following an UPDATE command.

Command Syntax

The command syntax for the UPDATE command is as follows:

```
AFU UPDATE [/C<Controller ID>] [/D <UFI File Path>]
```

Command Switches

For details on the /C and /D switches, see *SAVE* on page 72.

Examples

The following example shows a typical system response after an update has been performed:

```
A:\> AFU UPDATE /C 0

Adaptec Flash Utility V1.0-0 B1406
(c)Adaptec Inc. 1999-2005. All Rights Reserved.
Updating Controller 0 (Adaptec ASC-48300)
Reading flash image file (Build 1406)
AFU is about to update firmware on controller(s) Adaptec ASC-48300
***PLEASE DO NOT REBOOT THE SYSTEM DURING THE UPDATE***
This might take a few minutes.
Writing Adaptec ASC-48300 (4MB) Flash Image to controller 0...OK.
Verifying...OK
Please restart the computer to allow firmware changes to take effect.
```

VERIFY

The VERIFY command compares the contents of each of the flash components on a HostRAID controller to the corresponding image in a UFI file and indicates whether they match. Use this command to determine whether a HostRAID controller's flash components are up-to-date when compared to a specific UFI file.

Command Syntax

The command syntax for the VERIFY command is as follows:

```
AFU VERIFY [/C<Controller ID>] [/D <UFI File Path>]
```

Command Switches

For details on the /C and /D switches, see *SAVE* on page 72.

Example

The following example shows a typical system response after a VERIFY command has been performed:

```
A:\> AFU VERIFY /C 0
Adaptec Flash Utility V1.0-0 B1406
(c)Adaptec Inc. 1999-2005. All Rights Reserved.
Reading flash image file (Build 1406)
Controller #0: Adaptec ASC-48300
File: Checksum: 642C [VALID] (Build 1406)
File: Checksum: 642C [VALID] (Build 1406)
Verified Successfully
```

VERSION

The VERSION command displays version information about the flash components on a HostRAID controller.

Command Syntax

The command syntax for the VERSION command is as follows:

```
AFU VERSION [/C<Controller ID>]
```

Command Switches

For details on the /C switch, see *SAVE* on page 72.

Example

The following example displays version information about all supported HostRAID controllers:

```
A:\> AFU VERSION /C 0
Adaptec Flash Utility V1.0-0 B1406
(c)Adaptec Inc. 1999-2005. All Rights Reserved.
Version Information for Controller #0 (Adaptec ASC-48300)
ROM: Build 1406 [VALID]
```

AFU Command Line – Step-by-Step

This section provides step-by step instructions for updating the flash.

To update the flash using the AFU command line:

1. Shut down the computer.
2. Insert the bootable disk that contains the AFU utility.
3. Turn on the computer.
4. Enter the system setup utility and verify that your computer is set up to boot from the bootable disk.

5 If you have multiple HostRAID controllers only—At the DOS prompt, type `afu list`, then press **Enter**.

This command displays the Adaptec SAS HostRAID controllers in your system. Note the HostRAID controller number for the controller you want to update; you may need it in Step 6 to perform the update.

6 You can update the flash using any of the following alternatives:

a **Updating the Flash on a Single HostRAID Controller**—To flash the firmware on a single HostRAID controller, type:

```
afu update /C <controller_number>
```

Where *controller_number* is the number of the controller whose firmware you are updating. For example, to upgrade Controller 0, type:

```
afu update /C 0
```

b **Updating the Flash on Multiple Controllers**—To flash the firmware on multiple HostRAID controllers, type:

```
afu update /C <controller_number_a>,<controller_number_b>
```

Where *<controller_number_a>* and *<controller_number_b>* are the number of one of the Adaptec HostRAID controllers whose firmware you are updating.

To upgrade HostRAID controllers 0, 2, and 3 for example, type:

```
afu update /C 0, 2, 3
```

c **Updating the Flash on All HostRAID Controllers Simultaneously**—To flash the firmware on all HostRAID controllers, type:

```
afu update /C all
```

Note: The UFI file identifies the appropriate HostRAID controllers, so you do not have to worry about flashing the wrong controller.

7 The AFU prompts you to put in the first firmware disk.

When it detects that the disk is in the drive, the AFU reads the part of the firmware image contained on the first disk.

8 When prompted, remove the first firmware disk and insert the second firmware disk.

9 If necessary, repeat Step 8 until the process is complete.

Installing and Using the Command Line Utility

E

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HRCONF Commands 79

This Appendix explains how your SATA I/O controller supports the use of the HRCONF command line utility. This utility allows you to:

- Create and delete logical drives
- Display and modify a limited set of configuration settings
- Copy configurations from one computer to another
- Recover from a failed physical drive and rebuild an affected logical drive
- Enables the controller to check the removal and connection of any disk drives
- Restores the controller configuration

Installing the Command Line Utility

Both command line utilities are provided on the Adaptec Storage Manager CD. HRCONF is automatically installed in the same directory as Adaptec Storage Manager and must remain there.

Installing on Windows

To install HRCONF on Windows systems:

1. Start the computer.
2. After Windows starts, insert the Adaptec Storage Manager CD.
3. When the installation program starts, follow the on-screen instructions.

Installing on Linux

To install HRCONF on Linux systems:

1. Start the computer.
2. After Linux starts, insert the Adaptec Storage Manager CD.
3. Mount the Adaptec Storage Manager CD:

   Red Hat—`mount /dev/cdrom /mnt/cdrom`

   SuSE—`mount /dev/cdrom /media/cdrom`
4. Change to the cdrom directory:

   Red Hat—`cd /mnt/cdrom/linux/manager`

   SuSE—`cd /media/cdrom/linux/manager`
5. Extract the RPM package and install it:

   ```
   rpm --install ./StorMan*.rpm
   ```
6. Unmount the Adaptec Storage Manager CD:

   Red Hat—`umount /mnt/cdrom`

   SuSE—`umount /media/cdrom`

Installing on NetWare

To install HRCONF on NetWare:

You need the latest Support Pack for your operating system so you can run the supported Java Virtual Machine (JVM). You need JVM version 1.3 or later. To check your JVM version, load JVM, type `JAVA -VERSION`.

Note: For the latest updates from Novell, visit www.novell.com.

1. Insert the Adaptec Storage Manager CD.

2 From the command prompt, type `load cdrom` and press **Enter**. From the command prompt, type:

`xx_yy_zz:\netware\manager\install`

where *xx* is the product CD, *yy* is the version number, and *zz* is the release number. For example:

`adptcd_v2_01`

The installation program starts.

Follow the on-screen instructions to complete the installation.

Starting the Command Line Utility

To start HRCONF, enter one of the following commands:

- **Windows**—`c:\<install_dir*>\<name of utility>.exe`
- **Linux**—`/usr/StorMan/<name of utility>`
- **NetWare**—`load <name of utility>`

*Install_dir** is the directory where the utility is installed and *name of utility* is HRCONF.

To see a list of available commands, type HRCONF at the prompt. The utility command functions are detailed in *Using the Command Line Utility* (see next section.)

Using the Command Line Utility

This section explains how to use the command line utility interactively or in batch mode. With interactive mode, enter commands at the prompt. In batch mode, create scripts and run the script in the appropriate shell. For example:

Environment	Batch File	Run Script
Windows	.bat	CMD.EXE
Linux	.sh	sh / bash

In either mode, if your command fails, you immediately see an error message of Command failed. Other script messages that you can get are Command completed successfully, or Command aborted.

Available commands are described on the following pages, in alphabetical order.

HRCONF Commands

Perform the following functions from the command line:

HRCONF Commands		
backup	getstatus	setconfig
create	getversion	setstate
delete	rescan	task
getconfig	restore	

hrconf backup

For large-scale deployments, stores the current controller and disk drive configuration setting to a specific file. Stored files can be used with the `RESTORE` command to restore to another controller or disk drive. To restore, the controller or disk drive must have the same configuration as it did before the backup. For example: the same type of controller, same number and type of disk drives with same IDs and channels.

Syntax

`hrconf backup <Controller#> <Filename>`

Parameters

Controller# is the controller number

Filename is the relative or absolute path with filename

Example

hrconf backup 1 c:\windows\hr2200

Return values

SUCCESS: 0x00 indicates the command completed successfully

FAILURE: 0x01 indicates the command failed

hrconf create

Creates logical drives. You must provide the channel and device ID of the physical drives. On redundant logical drives, HRCONF performs autosynchronization.

Syntax

`hrconf create <Controller#> LOGICALDRIVE [Options] <Size> <RAID#> <CHANNEL# DRIVE#> [CHANNEL# DRIVE#] ... [noprompt]`

Parameters

Controller# is the controller number

Options indicates the logical drive with the following options:

- **Stripesize**—Optional parameters for specifying a stripe size. STRIPE is specified in kilobytes: 16, 32, and 64 are supported.
- **Name**—Optional parameter for specifying the name of the logical drive to be created.
- **Init_Priority**—Initialization Priority for logical drive to be created. Valid parameters are either HIGH, MED, or LOW.
- **Init_Method**—Initialization method for the logical drive. Valid options include: CLEAR, QUICK.

Size indicates the size of the logical drive. MAX is the only size option available.

RAID# indicates the RAID level for the logical drive (0, 1, 10 volume).

Channel# is the channel number for the device.

Drive# is the device number for the device.

noprompt: No prompt for confirmation.

Example

hrconf create 1 logicaldrive stripesize 64 max 0 1 0 1 1 1 2

Return values

SUCCESS: 0x00 successful termination

FAILURE: 0x00 bad arguments or internal error

hrconf delete

Deletes a logical drive. All data stored on the logical drive will be lost. Spanned drives can't be deleted with this function.

Syntax

`hrconf delete <Controller#> LOGICALDRIVE <LogicalDrive#> [noprompt]`

Parameters

Controller# is the controller number

LogicalDrive# is the number of the logical drive to be deleted

noprompt: No prompt for confirmation

Example

hrconf delete 1 logicaldrive 1 noprompt

Return values

SUCCESS: 0x00 successful termination

FAILURE: 0x01 bad arguments or internal error

hrconf getconfig

Lists information about the controllers, logical drives, and physical drives. This information can include (but is not limited to) the following items:

- Controller type
- Logical drive status, RAID level, and size
- Physical drive type, device ID, presence of PFA
- Physical drive state

Syntax

`hrconf getconfig <Controller#> [AD/LD/PD/AL]`

Parameters

Controller# is the controller number

AD/LD/PD/AL options:

- **AD**—Adapter information only
- **LD**—Logical drive information only
- **PD**—Physical device information only
- **AL**—All information (optional)

Example

hrconf getconfig 1 ad

Return values

SUCCESS: 0x00 successful termination

FAILURE: 0x01 bad arguments or internal error

hrconf getstatus

The `GETSTATUS` function displays the status of any background command that is currently running.

Syntax

`hrconf getstatus <Controller#>`

Parameters

Controller# is the controller number

Example

hrconf getstatus 1

Return values

SUCCESS: 0x00 successful termination

FAILURE: 0x01 bad arguments or internal error

hrconf getversion

Returns the version information for all controllers or the optionally specified controller.

Syntax

```
hrconf getversion
```

Parameters

Optional controller# prints the version information for the specified controller

Example

hrconf getversion

Return values

SUCCESS: 0x00

hrconf rescan

Enables the controller to check for the removal of any disk drives in the ready state, and to check for the connection of any new disk drives to the controller. The command returns when the rescan is complete.

Syntax

```
hrconf rescan <Controller#>
```

Parameters

Controller# is the controller number

Example

hrconf rescan 1

Return values

SUCCESS: 0x00 indicates the command completed successfully

FAILURE: 0x01 indicates the command failed

hrconf restore

Restores the controller configuration by importing it's configuration settings from a specified file. Deletes the current configuration. The file must have been saved through the BACKUP command from a controller of the same type, same number, and type of physical drives with same channels and device IDs. A reboot is required for the configuration change to take effect.

Syntax

`hrconf restore <Controller#> <Filename> [noprompt]`

Parameters

Controller# is the controller number

Filename is the name of the file to read the configuration from

noprompt: No prompt for confirmation.

Example

hrconf restore 1 c:\windows\hr2200 noprompt

Return values

SUCCESS: 0x00 indicates the command completed successfully

FAILURE: 0x01 indicates the command failed

BAD_PATH: 0xFF indicates that the path provided is incorrect

FAILURE: 0xFE indicates an error occurred writing the configuration file

hrconf setconfig

Resets the controller's configuration.

Syntax

`hrconf setconfig <Controller#> DEFAULT [noprompt]`

Parameters

Controller# is the controller number

Default: Resets the controller's configuration. Logical drives are deleted, disk drives are reset to the ready state, and any controller settings are reset to default values.

noprompt: No prompt for confirmation.

Example

hrconf setconfig 1 default noprompt

Return values

SUCCESS: 0x00 indicates the command completed successfully

FAILURE: 0x01 indicates the command failed

hrconf setstate

Redefines the state of a physical device from its current state to the designated state.

Syntax

```
hrconf setstate <Controller#> <Channel#> <Device#> <State>
```

Parameters

Controller# is the controller number

channel# is the channel number for the drive

device# is the device number for the drive

State options:

- **HSP**—Create a hot spare from a ready drive
- **RDY**—Remove a hot spare designation
- **RBL**—Rebuild drive

Example

hrconf setstate 1 0 1 HSP
hrconf setstate 1 0 2 RDY
hrconf setstate 1 0 2 RBL

Return values

SUCCESS: 0x00 indicates the command completed successfully

FAILURE: 0x01 indicates the command failed

hrconf task

Performs a task on a logical drive.

Syntax

```
hrconf TASK START <controller#> LOGICALDRIVE <LogicalDrive#> <options>[noprompt]
hrconf TASK STOP <controller#> LOGICALDRIVE <LogicalDrive#>
```

Parameters

Logical drive# is the number of the logical drive in which the task is to be performed

Options—Tasks to be started or performed

Example

Logical Drive Options:
verify_fix (Verify with fix)
verify
clear

Return values

noprompt: No prompt for confirmation

Safety Information

F

To ensure your personal safety and the safety of your equipment:

- Keep your work area and the computer clean and clear of debris.
- Before opening the system cabinet, unplug the power cord.

Electrostatic Discharge (ESD)

Caution: ESD can damage electronic components when they are improperly handled, and can result in total or intermittent failures. Always follow ESD-prevention procedures when removing and replacing components.

To prevent ESD damage:

- Use an ESD wrist or ankle strap and ensure that it makes skin contact. Connect the equipment end of the strap to an unpainted metal surface on the chassis.
- If a wrist strap is not available, ground yourself by touching the metal chassis before handling the controller or any other part of the computer.
- Avoid touching the controller against your clothing. The wrist strap protects components from ESD on the body only.
- Handle the controller by its bracket or edges only. Avoid touching the printed circuit board or the connectors.
- Put the controller down only on an antistatic surface such as the bag supplied in your kit.
- If you are returning the controller to Adaptec, put it back in its antistatic bag immediately.

Technical Specifications

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DC Power Requirements 87

Current Requirements 87

Environmental Specifications

Relative humidity	10% to 90%, noncondensing
Altitude	up to 3,000 meters

Note: Forced airflow is recommended, but not required.

DC Power Requirements

Ripple and noise	50 mV peak-to-peak (max)
DC Voltage	3.3 V ± 10%

Current Requirements

Adaptec Model	Maximum Current (A)
ASC-58300	0.56A
ASC-48300	1.322A
ASC-44300	.445A

Glossary

A

activity
See *task*.

ACU
Array Configuration Utility. An application used to create, configure, and manage arrays from the controller's BIOS or MS-DOS.

array
A logical disk created from available space and made up of one or more segments on one or more physical disks. Arrays are typically used to provide data redundancy or enhanced I/O performance. See *volume*, *spanned volume*, *RAID 0*, *RAID 1*, *RAID 10*. Also known as a container.

array initialization
See *configure*.

ATA
AT Bus Attachment. Standard parallel interface to IDE hard disks typically used in desktop computers and some entry-level servers. Serial ATA (SATA), is a successor to parallel ATA, which is sometimes referred to as PATA.

available space/segment
Unused space on a configured disk from which logical devices (arrays) are created. When an array is deleted, the space that it used is returned to the available space pool.

B

background consistency check
Option that forces the controller to constantly check all portions of disks used by all arrays to see if the disks can return data from the blocks. See *consistency check command*.

bad segment
Segment that is in an unknown state.

bootable array
Array configured as the boot device.

build
Background initialization of a redundant array. The array is accessible throughout. RAID 1 copies the contents of the primary drive to a secondary drive. See *clear*.

bus
See *channel*.

C

cache
Fast-access memory on the controller that serves as intermediate storage for data that is read from, or written to, drives.

capacity
Total usable space available in megabytes or gigabytes.

channel
Any path, or bus, used for the transfer of data and the control of information between storage devices and a RAID controller. For SATA channels, each channel has a single drive capacity.

check point
A feature that enables you to exit the ACU when an operation is in progress and be able to continue without interruption. The driver then resumes the operation from where the BIOS left off and the BIOS resumes the operation where the driver left off.

chunk
See *stripe*.

clear
Foreground initialization of a fault-tolerant array. A clear operation zeros all blocks of the array. The array is not accessible until the clear task is complete.

concatenation
Joining of physical or logical drives in sequential order.

configure
Process of preparing a disk for use by the controller. When a disk is configured, the controller records the RAID signature on the disk.

configured array
An array that is ready for data reads and writes. Arrays can be configured by build or clear.

consistency check command
Command that reads all the blocks of a RAID 1 to determine if the blocks are consistent. Any inconsistent blocks are fixed.

D

dead partition
See *failed*.

degraded
A redundant (for example, a RAID 1) array in which one or more members have failed. The data is intact but redundancy has been compromised. Any further failure would cause the array to fail and result in data loss.

disk
Physical disk drive. Randomly accessible, rewriteable data storage device. Also called hard disk.

disk ID
Unique disk identifier that consists of the channel number, SATA ID. For example, (channel:ID:LUN) 1:04:0. See *channel*.

drive LED
Disk indicator LED that illuminates during read or write operations.

E

event
Notification or alert from the system, indicating that a change has occurred.

event log
File used to maintain information about prior controller activities or errors.

event notification
Process for transmitting events.

F

failed
State of a nonredundant array that has suffered a single drive failure, or a redundant array that has suffered multiple drive failures. A failed array is inaccessible and data is lost.

fault-tolerant array
Refers to an array that can continue to function after a disk drive failure without loss of data. Fault tolerant, or redundant arrays, include RAID 1 arrays. See *redundant*.

foreign disk
Disk that has previously been configured on another Adaptec RAID controller. The RAID signature on the disk allows the RAID controller to identify whether or not the disk was configured on the controller it is currently connected to.

H

hard disk drive
Basic unit of nonvolatile, nonremovable, magnetic storage media. See *disk*.

hot spare
A spare hard disk that automatically replaces a failed hard disk on any array associated with any HBA.

hot swap
To remove a component from a system, and install a new component while the power is on and the system is running.

I

impacted
An impacted array is one which has been created but for some reason the initial build operation did not complete. All member drives are present and operational, and all data written to the array is protected. To optimize the array, run a Verify with Fix Task.

initialize
See *configure*.

L

legacy disk
Disk that contained a valid partition table when connected to the controller. The controller manages the disk as a legacy disk array where there is a one-to-one logical-to-physical mapping of array to disk.

logical device
Volume comprised of space from one or more physical drives and presented to the operating system as if it were a single storage unit.

low-level format
Process performed by the drive firmware that completely cleans any data off the hard disk.

M

mirrored array/mirroring
See *RAID 1*, *RAID 10*.

monitoring
Process of receiving, displaying, and logging system events.

N

Native Command Queuing
Allows disk drives to arrange commands into the most efficient order for optimum performance.

O

offline array
Array that can no longer be accessed.

optimal
The state of an array when it is fully operational. For redundant arrays, the entire array is protected.

P

partition
A section of a disk storage device created by the operating system disk management program, in which data and/or software programs are stored. Computers have a primary operating system partition that contains the special files needed to boot the computer. Each operating system partition is assigned a unique drive letter, such as C or D. A single disk device can have multiple partitions.

phantom object
Object that represents a component that cannot be configured by the controller management software; for example, a missing drive.

Q

quick init
An array configured using the Quick Init option is available immediately, with no on-going background controller activity. All data written to an array that has been quick configured is protected.

R

RAID
Redundant Array of Independent Disks (alternative definition Redundant Array of Inexpensive Disks).

RAID 0
A single-level array consisting of two or more equal-sized segments residing on different disks. RAID 0 distributes data evenly across its respective drives in equal-sized sections called stripes. RAID 0 arrays are not redundant.

RAID 1
Single-level array consisting of two equal segments residing on two different drives. Provides redundancy by storing identical copies on two drives. See *mirrored array/mirroring*.

RAID 10
Spanned array consisting of two or more equal-sized RAID 1 arrays. Provides redundancy by striping and mirroring. Mirroring provides data protection, and striping improves performance. See *mirrored array/mirroring*, *RAID 0*.

RAID signature
The area on each disk reserved for use by the RAID controller.

RAID volume
Concatenates two or more arrays of the same type.

rebuild
Background regeneration of redundant data on a RAID 1.

redundant
The ability of an array to maintain operability when one or more hardware failures occur. RAID 1 is redundant. In the event of a drive failure, redundant arrays can be restored to normal operation by replacing the failed drive and rebuilding the array.

rescan
Process of updating the current screen to show all currently available resources.

S

Serial ATA (SATA)
A successor to ATA that uses a serial, instead of parallel, interface.

simple volume
A volume made up of disk space from a single disk. It can consist of a single region on a disk, or concatenated multiple regions of the same disk.

single-level array
Array created from one or more segments. See *volume*, *spanned volume*, *RAID 0*, *RAID 1*, *RAID 10*.

snapshot
Instantaneous read-only copy of an array at a precise point in time.

spanned volume
A simple volume that spans two or more drives.

stripe
Contiguous set of data distributed across all the disks in an array. A striped array distributes data evenly across all members in equal-sized sections called stripes.

stripe size
The amount of data in each section of a striped array.

striped array
See *RAID 0*, *RAID 10*.

T

task
An operation that occurs only on the RAID controller, asynchronous to all other operations; for example, initializing a disk or verifying an array. Some tasks can take an extended period of time, particularly if the RAID controller is also performing intensive data I/O while the task is running.

V

verify
Low-level check that a drive, logical device, or hot spare is good. In a RAID 1, verify is a low-level check that contents of both members' segments are consistent and, optionally, corrects errors while assuming that the master drive is correct. In a simple volume, verify performs a low-level check that the whole drive can be read.

volume
See *simple volume*, *spanned volume*.

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Adaptec, Inc.
691 South Milpitas Boulevard
Milpitas, CA 95035 USA

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